HOW SPIDERS BEHAVE

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XI. No. 125. MAY, 1930. PRICE 1s. NET

ON THE TRACKS OF THE GORILLA.
(See page 162)

CHIEF CONTENTS.

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Editorial Notes.

New discoveries in Byzantine art are announced in this issue by Mr. Stanley Casson. The church where the discoveries were made is itself remarkable for its architecture, while the contents of the building must rank as the most important which have come to light in Constantinople during recent years. Had it not been for a fire, these priceless treasures would have remained embedded in the plaster that was added when the original structure was converted into a mosque in 1496. Since the war the Turkish museum authorities have afforded every courtesy to foreign archaeologists, and it was as the result of suggestions from Oxford that the ruined church was excavated. The special character of St. Saviour Pantokrator had been recognized before by various visitors, notably Professor Van Millingen, and possibly in course of time the museum authorities would have explored the church. As it is, the fire may be regarded as a blessing in disguise, since the process of discovery has been hastened. Many features were destroyed, but others of great value have remained intact, and the church is now to be restored as a monument of Byzantine art. The original building included five apses and is the first authentic example of this very rare design. More remarkable still were two chapels hidden in the roof, one of them containing a marble icon that is probably unique as a work of art. Other discoveries include an icon carved with a scene from the New Testament not yet interpreted, and a marble head of Christ showing features new to sculpture. Archaeologists rarely reveal material which makes an equally strong appeal to the public as to specialists, and in this case it is very appropriate that the first account should appear in our columns.

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The newspapers gave a good deal of publicity to a wireless experiment some weeks ago, in which Senator Marconi pressed a button in Italy and lit some lamps ten thousand miles distant in Australia. The progress of wireless technique was certainly illustrated, but from the details available it is evident that no new principle was involved. The result depended on a highly sensitive relay, which was actuated by ordinary wireless waves and thereby caused to operate a lighting switch. This could have been done at any time since the inauguration of beam transmission apparatus. Only in this sense were lamps "lit by wireless," and all suggestions that the experiment heralded an era of wireless power transmission were entirely premature. We have often remarked on the muddled terminology employed by journalists in regard to television and photo-telegraphy, and, generally speaking, confusion occurs about most scientific matters in the newspapers. Even *The Times* referred to this Marconi experiment as involving "the transmission of power by radio."

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The explanation is, of course, that few journalists have enjoyed a scientific training, and that however much they may have read, there is all the difference between knowing and "knowing about" a scientific subject. This distinction is admirably stressed by Professor Arthur Smithells, in a recent contribution to the *Listener*. Dealing with the study of chemistry, he points out that the subject cannot be learnt by reading alone. This limitation does not apply to history and literature, but it must be recognized as fundamental in regard to most branches of science. "It is hoped that this distinction may not seem trivial and pedantic," Professor Smithells writes. "It is really very important and perhaps it is worth a little more explanation. Chemistry is an experi-

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mental natural science, that is to say, it is based on the observation of processes going on among material things. (It seems almost a pity that we did not follow the French and use the word 'experience' instead of 'experiment.') You can no more learn chemistry without experimentation or experience than you can learn cabinet-making without shaping and fitting pieces of wood." Almost anyone can follow intelligently the story of a masterpiece of cabinet-making, but when it comes to the practical results of a science like chemistry, most readers experience "a profound and almost painful sense of their ignorance of *how* such discoveries are *begun upon*." We quote these points not by way of complaint—that is far from their author's intention or ours—but to illustrate the difficulties of every writer who endeavours to deal with a scientific subject in a popular way.

* * * * *

Six months ago we predicted early success for the Baird television apparatus, of which we had been afforded a private demonstration. This was before the completion of the Brookman's Park station, when it was necessary to broadcast speech and images alternately, no dual transmitter being then available. The opening of the new station in March has now been followed by a public test, at which sound and images were broadcast simultaneously under the auspices of the British Broadcasting Corporation. It is just five years since Mr. Baird published in *Discovery* the first article on his invention, and the progress made in this short period is truly amazing. We were able to report last November that the original "flickering" was scarcely noticeable. This disturbance has now been still further removed, so much so that one observer declared the result to be better in this respect than the talking films. No lag was observed between vision and sound, such as often destroys the illusion of the "talkies." In the Brookman's Park experiment, speech and images were transmitted on wave-lengths of 356 and 261 metres respectively. We are informed that television receiving sets are now on sale at twenty-five guineas, and that parts for home construction are priced at sixteen guineas. At the time of writing it has not been announced whether transmission will yet be made during B.B.C. programme hours.

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A contributor to the April issue of the *Telegraph and Telephone Journal* humorously discusses past failures to achieve wireless communication with Mars, and suggests a fantastic combination of telescopes and valves as an alternative means to this end. Although we have no great faith in the possibility of establishing communication with inhabitants of other planets—should there be any of sufficient intelligence and mechanical skill within the solar system—it is an interesting thought that television apparatus would be of much greater practical use for the purpose than either Morse signals or telephony. Assuming that waves could be induced to penetrate the Heaviside layers of the earth and Mars and travel in a beam between the two worlds, the transmission and reception of pictures would provide a method of establishing comprehension which would be almost impossible by any auditory system. But we fear that the prospects of finding planetary neighbours equipped with the necessary apparatus are remote!

* * * * *

We review this month the report of an international flying competition, held in America, in which a British commercial machine attained a leading place. Private flying also is making steady progress, and the first "air yacht" has now been constructed for a private owner. It belongs to Mr. A. E. Guiness, the well-known yachtsman, and is a three-engined Supermarine monoplane model. This air-yacht has a cruising speed of 100 miles per hour, and will normally carry a crew of three, and six passengers. Dual control is fitted, also two open cockpits for the use of passengers. The luxurious interior has sleeping berths, a small bath-room, a cook's gallery and every convenience to be found in a seagoing yacht. Marconi wireless apparatus has been fitted, equivalent in power and range to the normal installation on a ship of about 5,000 tons. This will ensure the passengers' safety, should the flying boat break down at sea.

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It is possible that the articles on "The Next Step in Science," published in our columns last year, may be reprinted shortly in book form. The most striking advance in knowledge since the war has been the general recognition that science may no longer be divided into water-tight compartments. This fact clearly emerges from the writings of modern experts, especially when they are read in close succession. Another tendency of present-day knowledge is the readiness on every hand to admit its limitations. More facts than ever before are at our disposal, and every new discovery testifies to the unity of science. Yet in face of this situation or perhaps as its outcome, the greatest thinkers are inclined to generalize, even on matters where not many years ago the "facts" would have been regarded as finally established. As time goes on it will be interesting to see to what extent the predictions in our pages have been justified.

New Aspects of Byzantine Art.

By Stanley Casson, M.A.

The following is the first account published of new discoveries in Byzantine art, which must rank as the most important made in Constantinople in recent years. A marble icon of a style hitherto unknown, also a sculptured head of Christ of remarkable beauty, are among these important finds.

EXCAVATIONS were carried out by the authorities of the Museum at Stamboul last autumn in a ruined mosque known as Feneré Issa Mesjedi. This mosque was in origin the ancient Byzantine church of St. Mary Panachrantos—"The Immaculate Virgin." Owing to a devastating fire in 1916 in the district where the church stood it was partly damaged, and left unused and in a derelict condition. Since there was the possibility of it being pulled down during the course of the extensive town-planning and street widening now taking place in Stamboul, the authorities wisely decided to excavate the interior of the church and to clear its walls of the plaster which had been added during the Turkish occupation, in order to see whether much of the original decoration of the Byzantine church could be saved. The excavations were carried out under the supervision of Makridy Bey, Assistant Curator of the Stamboul Museum, and with the permission of the Republican Government of Turkey and of Halil Bey, the Director of the Museum. They constitute a notable contribution by the Turkish authorities to Byzantine archaeology.

The results were surprising in their richness, and so successful has the clearance been that it has now been decided to leave the church intact and restored as another monument of Byzantine art and architecture in the city. The artistic and architectural discoveries can rank as the most important made in Constantinople for many years for the furtherance of our knowledge of the Byzantine world.

Obscure Origin.

The actual origin of the church is at present obscure. There seems to have been in the first instance a small church erected on the spot in the sixth century. This is clear both from architectural evidence and from certain marble architectural decoration found during the excavations. But the church of the Panachrantos first appears in recorded history when a certain Constantine Lips, an important public official in the reign of Leo the Wise in the late ninth century, restored a monastery and church in the district where the building now stands. The actual dedication of the church took place in the year 908 in the month of June. The emperor attended the ceremony and a banquet followed in the refectory of the monastery. Constantine Lips, after a period of uncertainty, once more attained distinction under the next Emperor Constantine VII, and the church he had dedicated was now well known in the city. The name of the founder is preserved in a long marble inscription which runs as a cornice round the outside of the eastern apses of the church. The Turkish occupation of 1453 did not affect the church, which like many, remained a Christian place of worship. But in 1496 it was converted into a mosque. This it would have remained until to-day had not the disastrous fires of 1916 left it in a partially ruined condition, and so made it possible for it to be examined by archaeologists.

Five Apses.

The first stages of the excavations revealed much of the greatest importance. First of all it was found that the church was definitely a double one, resembling in general structure the triple church of St. Saviour Pantokrator. Those, such as Professor Van Millingen,* who had examined the church while it was still in use as a mosque, had come to the conclusion that there had originally been one church, that on the south, to which later the northern church had been added. Each was supposed to have had three apses and to have been a "triple-nave" type of church. But the earliest stages of the excavations revealed that the northern church was the earlier and that it had originally had five apses. One apse had then been removed on the outside, and a second church had been added on the south into which still another of the five apses had been incorporated, with the result that there were then two churches with three apses apiece. Later an outer gallery had been added on the west and south sides. The discovery that the original church had been one with five apses is of great importance. The five-apse type is very rare and thought to be peculiar to the city. This is the first fully authenticated instance known, though it is possible that the church of St. Saviour in the Chora may have been of the same type.

* "Byzantine Churches of Constantinople" (1912), p. 122.

But these architectural discoveries were dull in comparison with the artistic discoveries which rapidly followed. As the walls were cleared it was soon apparent that the bulk of the elaborately carved cornice and pilaster marble decoration had survived. The cupola of each church in the double building was surrounded with superb ornamentation, particularly in the case of the north church, where five Byzantine eagles, heraldically displayed, formed an integral part of the design. The corbels of the apse windows of the north church were equally well decorated with surmounting capitals again adorned with eagles. In both cases the eagle was of the tenth century type with a single head.

In the floor of the church no fewer than twenty-two tombs were found, but of these all but three had been opened by the Turks, probably in the fifteenth century. But we know from literary sources that many distinguished persons were buried in the church, amongst them the Emperor Andronic II, Theodora, wife of the Emperor Michael Palaeologue, and Eudoxia, wife of John Comnenos, Emperor of Trebizond. It is probable that one of those found unopened was that of Theodora. Elsewhere a fine area of marble mosaic floor was found and, heaped up in some of the tombs, fragments of marble sculptures of the greatest importance. Amongst the sculptures must rank as of the greatest beauty a series of heads in white marble showing Christ and the Apostles. The head of Christ must rank as one of the finest achievements of Byzantine sculpture of the tenth century. Its similarity in style to the finest ivory carvings of this century is at once apparent, and it is interesting to see how the stone cutter seems to have followed the traditions and style of the minor craftsman, rather than the larger traditions of the sculpture of Greece and Rome. Of the minor objects found one of the most interesting was a large part of a steatite icon, exquisitely carved, depicting a scene from the life of Christ which has not yet been satisfactorily interpreted. This small icon was found in a tomb.

The chief surprise came when in the course of a systematic examination it was found that there were two small chapels hidden in the roof. These were cleared and found to be in remarkably perfect condition. Near one of them was made the most important discovery of all. There was found face downwards on the floor a superb marble icon upon which was shown the full-length figure of a saint—St. Eudoxia—which was worked in inlaid coloured marbles of great beauty and refinement. The icon itself is a thin slab of white marble measuring 0.67 metre in height and 0.28 broad. It was made with extreme delicacy and care; the figure of the saint was carved out of the marble in intaglio, and the spaces so cut were filled with pieces of coloured marble appropriately shaped. In effect the method is that of the enameller or the worker in *champlevé* rather than that of the mosaic worker. It is the art of the jeweller transferred into stone. As such it is the first authentic example of its kind and a thing of remarkable loveliness. The face and hands are in rose-coloured marble; the halo is in yellow, the garments purple and green, studded with stones to resemble gems, and the surrounding frame is in yellow and green with central points of red and green.

APSE WINDOWS OF THE NORTH CHURCH.

The surmounting capitals are adorned with eagles. The removal of plaster revealed much beautiful carving of the ancient church.

SAINT MARY PANACHRANTOS VIEWED FROM THE EAST.
The building consists of two churches, of which the original portion had five apses only—a very rare design and the only fully authenticated instance so far known. On the eastern frontage, viewed in this photograph, the six apses have remained intact and almost undamaged.

The background upon which the figure is drawn is of plain white marble. The head is surmounted by a lovely crown in various colours of a type frequently met with in goldwork and ivories.

At present it is impossible to be precise about the date of this work of art, but it is probable that it is of the eleventh century. As an example of an almost unknown mode of art it constitutes one of the most remarkable works of Byzantine art ever discovered. It is now to be seen in the Byzantine gallery of the National Museum of Antiquities at Stamboul. We have no literary record of work of this kind and, except for one fragmentary example of a similar icon in the Byzantine Museum at Athens, no other instances. But among the marble fragments found in the tombs of this church there were two which were from similar icons in marble. One showed St. George mounted upon a horse, the other a simple standing figure of the Saviour. In each case the coloured marble filling had vanished, and all that was left was the white marble slab core with the design cut out in intaglio. From these fragments and the complete icon of St. Eudoxia it seems probable that this church was peculiar for its decoration with this type of votive icon. Certainly no other examples are known from Constantinople except for one fragment the origin of which is uncertain.

Whatever frescoes or mosaics adorned the walls of the church seem to have vanished. There is some record of an earlier fire having taken place in 1643, which must have destroyed such perishable adornments. But the main structure of the church has now been cleared and, as such, it is clearly a building of great refinement and beauty. The two churches are of almost the same dimensions, and are thrown together to make one double building. A narthex, or ante-chapel, communicates to both and the side gallery on the south enlarges the area. Both these features were probably added in the fourteenth century, and in them are placed many of the tombs. The side gallery serves, in effect, as a cloister to the main building, as does the side gallery in the church of St. Saviour in the Chora. From the north, south and west sides the church presents a simple rectangular front, but from the east the six apses of the two churches with their surmounting cupolas remain intact and undamaged—a splendid example of Byzantine church-building of the time when attention was at last paid to external considerations instead of being confined only to interiors, as in the case of St. Sophia and all churches of that period. The charming effect of the six apses at the east end is heightened by the addition of

marble external cornices and of delicate pattern-work in the red brick walls.

St. Mary Panachrantos is but one of many half-derelict churches the examination of which might well be productive in artistic and architectural discoveries. Only last year a superb mosaic has been found in the well-known Kahrieh mosque, and the possibilities of discovery are still only beginning to be realized. Nothing quite so important from a purely artistic point of view has been found in any of the Byzantine churches of the capital in recent years.

It is difficult as yet to estimate the importance of the principal artistic discovery, the marble icon. This style of work is virtually unknown, and the discovery of the icon, together with that of fragments of similar icons, must revolutionize our views upon some aspects of Byzantine art of the tenth, eleventh and twelfth centuries. Our only comparisons are, for the moment, with Byzantine ivories. The closest seems to be with the famous ivory triptych-panel in the Louvre,* which shows the Emperor Romanus and his wife Eudoxia crowned by a figure of Christ who stands between them. Here the garment worn by the Empress is very similar to that worn by the Saint Eudoxia; the attitude also is much the same, and the crown and halo identical. The embroidery of the dress of the Empress in the ivory shows exactly the same double-lozenges as on the marble icon and the same roundels on the shoulders. But the Saint wears a belt and the Empress does not. The parallel is so close that we cannot avoid the conclusion that our icon is of approximately the same date as the ivory panel; and the date assigned to the ivory is the eleventh century.

ST. EUDOXIA.

This figure is worked in inlaid coloured marbles of great beauty and refinement. As an example of an almost unknown mode of art it constitutes one of the most remarkable works of Byzantine art ever discovered.

A CARVED ICON.

Part of a steatite icon representing a scene from the life of Christ which has not yet been satisfactorily interpreted. The complete icon originally consisted of a series of similar panels, each depicting a separate scene and exquisitely carved.

We are thus in possession of a priceless addition to our knowledge of Byzantine art of this period. In many ways the tenth and eleventh centuries form the most interesting period in the whole artistic history of the Byzantine world. With the close of the Iconoclastic period in A.D. 842 there came a powerful renaissance of art under the Macedonian and Comnene emperors. New styles, new methods and new techniques appeared on every side. Sculpture in stone and marble developed upon wholly new lines and favoured relief rather than sculpture in the round. But the marble reliefs known of this period are among the most perfect works of art of any age; a notable instance is the superb but shattered relief of the praying Virgin, found in the ruins of the Mangana Monastery in 1919. As skill in relief carving developed among sculptors so it increased among ivory carvers, and ivories of the tenth and eleventh centuries are among the finest of any age. And, just as sculptors in stone abandoned sculpture in the round, so also did the ivory carvers. There is only one considerable work of art in the round in ivory in existence that belongs to this period—the lovely Madonna in the South Kensington Museum. The whole tendency of the age was

* Dalton: "Byzantine Art and Archæology," Fig. 228.

towards increased formalism, combined with as much flatness in technique as a relief carving can achieve without actually becoming a mere engraving on stone or ivory. In the same way mosaic-work was now at the highest point of development, for an abandonment of the high relief of earlier periods in sculpture led to a greater absorption in the arts of painting and drawing. Painted panel-icons of the eleventh and twelfth centuries, like the famous Virgin of Vladimir, show to what heights the draughtsman and painter had climbed.

The Iconoclastic movement that started in the eighth century had at least served one useful purpose. It had sent underground the latent love of realism and representation which Byzantium had inherited from the Western Romans and the Alexandrian Greeks, and had led to the revival in the tenth century of a purged and chastened love of pure form, which was in the essential Greek character from the earliest times. Byzantine art of the tenth century A.D. thus has qualities of simplicity and formalism which link it much more with Archaic Greek art of the sixth century before Christ than with any other age. Somehow, the essential Greek genius had emerged once more.

MARBLE HEAD OF CHRIST.

This discovery has set a new standard for stone sculpture of the tenth or eleventh century to which it belongs. In technique, also, the curious double folds above the eyes, the slanting lids and the treatment of the hair are without parallel.

The icon of St. Eudoxia, then, is an example of a new form of Byzantine art which falls half way between sculpture and mosaic. It has achieved the effects of both those arts—the solidity of sculpture and the liveliness of stone combined with the colour and the graphic qualities of mosaic. The face and hands, in rose-coloured marble, however, seem to combine the sculptor's art with that of the painter. The features and details are lightly engraved on the stone, and yet the effect is still sculptural. As a work of art it is an astonishing example of a medium hitherto unknown to any period of art.

The sculptured head of Christ is remarkable in the fact that it is an exception to the general practice of the period to which it belongs—the tenth or eleventh century. It is in much higher relief than is the usual custom, yet in style and appearance it is clearly of this same period of renaissance. It still has the stern severe features of the Christs of tenth and eleventh century mosaics and ivories. It can be classed with the head of the Pantokrator of Daphni Monastery (near Athens), perhaps the finest eleventh century mosaic in existence, rather than with the more humane and sympathetic heads of fourteenth century iconography. In technique also, it gives us much new knowledge. The curious double folds above the eyes, the slanting lids and the treatment of the hair are without parallel. It has itself set a new standard for stone sculpture of this period. Two other fine heads were found with it, but there is nothing quite so distinctive or so distinguished about them as about this particular head.

Our knowledge of the chronology of Byzantine art of the Macedonian and Comnene period is pathetically limited. It is hardly possible as yet to date any given piece within half a century, at the least, for our fixed points are so few and far between. The reason is, simply enough, our lack of material. Despite the thousand years during which Constantinople and the Byzantine Empire preserved behind its walls and its frontiers those elements of culture which were to establish the future of Europe, we have less material evidence for that culture (except perhaps in architectural remains) that for any other thousand years of known history. The great European Museums possess few examples. The looting of Constantinople by the Crusaders in 1204 and the subsequent capture by the Turks in 1453 did more between them to destroy the material vestiges of a great Empire than any other sack or occupation in history. That explains why objects of Byzantine art, whenever they may chance to appear upon the market, command higher prices than the artistic products of any other age.

British Universities To-day : (5) Oxford.

By Sir Herbert Warren, K.C.V.O., D.C.L., LL.D.

President of Magdalen College, 1885-1928 ; sometime Vice-Chancellor.

After fifty years of active administration in the University, Sir Herbert Warren brings a unique experience to bear in discussing the Oxford of yesterday and to-day. He traces clearly the reforms by which the oldest university in the English-speaking world has retained its position in the van of intellectual progress.

See with how placid mien Athena unhelmeted
Rëentering hath possessed her desolated halls :
How her musical temples and grave schools are throng'd
With fresh youth eager as ever with the old books and games,
Their live abounding mirth rëechoing from the walls,
Where among antique monuments their brothers' names
In long death-roll await the mellowing of time.

ROBERT BRIDGES, *The Testament of Beauty.*

ENGLAND is an old country and her capital institutions are old. Her navy, whatever may be its future, was started, it is said, by Alfred the Great. Oxford's oldest College was at one time credited with a coeval and similar origin. Though that belief no longer obtains, Oxford is still old, an offshoot perhaps of Paris, but the oldest university in the English-speaking world. It is significant that Herr Wilhelm Dibelius of Berlin should open his full and fair account of the English universities by emphasizing this fact. And Oxford even to-day *looks* old. True her main thoroughfares are choked with modern motor traffic. Their old houses are vanishing. But step into the side streets, the Turl, or better still Queen's and New College Lanes or Merton Street ; into the sunny or sombre cloisters of Magdalen or New College, the Old Congregation House of St. Mary's, the Divinity School, the Bodleian, or the old Library of Balliol or Merton ; contemplate Mob Quad, or the Benedictine Hostelries of Worcester, and you are translated by centuries from the present into the past. It is the national genius to "reform that it may preserve." "In England," said the Comte de Montalembert visiting Oxford in 1855 for his D.C.L. Degree, "you do not destroy the past." It was at the very moment when Oxford was being for the first time reformed by state authority.

What was the old unreformed Oxford like? we may ask, if we wish to appreciate the new. The year 1830, of which to-day is the Centenary, was the real beginning of change, the eve of the era of "reform," of the railways, of the Oxford Movement. The last two affected Oxford intimately, profoundly. It was the year, as it happened, in which Gladstone at Oxford and Tennyson and Darwin at Cambridge came of age ; the year in which Arthur Hallam, Monckton Milnes and Sunderland came over to maintain in debate at the newly founded "Union," against Manning, Gladstone, and others, that the Oxford Shelley was a better poet than the Cambridge Byron.

The Oxford Calendar of 1830 records 2,510 Members of Convocation, with 5,229 Members on the books, and matriculations 426. That of the present year, 1930, Convocation 8,403, on the books 21,204, matriculations 1,533. In 1830 there were nineteen Colleges and five Halls. To-day there are twenty-one Colleges and five Halls for men, four Colleges or Halls for women, and also the men's "Non-Collegiate Society" and the women's "Society of Home Students." To these, though not strictly part of the university, may be added Ruskin College, by no means unimportant, sending a number of its old students to the House of Commons, and the Catholic Workers' College. In 1830 there were twenty-two professors and praelectors. Among them, it is true, there were some of mark, but there was not even a professor of Latin. To-day there are some seventy-five professors, and an army of readers, lecturers and demonstrators teaching and researching, in the ancient phrase, *de omni scibili, et quibusdam aliis.*

The "Institutions."

A hundred years ago the university was ruled by the Vice-Chancellor, the Heads of Colleges, and the Proctors, these also the nominees of the Colleges. Convocation was scattered over a country without railways, and the resident M.A.'s, celibates tied to their Colleges, as a rule only ratified and registered. The "Institutions" were (1) the Bodleian, (2) the Radcliffe Library, (3) the Sheldonian Theatre, (4) the (old) Ashmolean, (5) the Observatory, (6) the Clarendon Press, (7) the Physic Garden.

How do these stand to-day? The Bodleian, first in every sense, still shows its original staff of a librarian and two sub-librarians, but with sixteen senior

assistants, and superintending four departmental libraries. The Radcliffe books have been moved to the Museum, and the classic, domed Camera is an annexe to the Bodleian. The beautiful old Ashmolean, built in 1683, with its chemical laboratory, then the only one in Oxford, was even in 1710 in a neglected state. To-day, thanks to Dr. R. T. Günther, it has been brought again into handsome order and houses the choice Lewis Evans collection of scientific instruments. The Observatory may ere long lose its astronomical character and be attached to the Radcliffe Infirmary. It is to be hoped that the picturesque " Temple of of the Winds " will be preserved. The Clarendon Press of 1830, then recently moved into a large business building, though on a collegiate model, has long outgrown its bounds. Its operations are world-wide, its output as vast as it is various. The Sheldonian Theatre alone remains little changed.

Constant Growth.

To-day the university institutions, with their divisions and dependencies, have been immensely multiplied to keep pace with the constant growth of Oxford's studies. The development of these may be well traced in the history of the Honour Schools. In 1803 the first honours were awarded in classics and mathematics combined. In 1807 the two were divided. Some fifty years later natural science and law-and-history were added. In 1872 law and history were divided, and by degrees theology, oriental languages, English, modern languages were added, and finally, in 1923, philosophy, politics, and economics. Meanwhile in the Science School separate subjects were recognized—physics, astronomy, physiology, chemistry, zoology, botany, geology, engineering. Side by side came necessarily the growth of new Institutions and new teachers. The purchase of the parks and the erection of the Museum in the 'fifties made an epoch. In and around the Museum alone to-day are contained or grouped some fifteen departments, with their several laboratories, lecture rooms and staffs.

The four old Faculties, theology, law, medicine, and music, have each and all made advance. Theology had the least need to do so, for in 1830 the University and Colleges were mainly seminaries of the English Church. Glance at the college lists of that date. Almost all the Heads and Fellows were clergy. So were all but a sprinkling of the M.A.'s and the senior B.A.'s. Among the undergraduates there were not a few noblemen and gentlemen-commoners, but the vast majority of the scholars and commoners evidently looked toward Holy Orders.

The period succeeding the stormy spring of the " Oxford Movement " was a rich and famous summer but the theological faculty is strong to-day, and is supplemented by the foundation of Keble (1870) and now of St. Peter's Hall, by the advent of the Free Church Colleges, Mansfield and Manchester, and by the various institutions for study and training, Pusey House, St. Stephen's, Wycliffe, Ripon, and the Roman Catholic Halls. The divinity degrees previously confined to Anglican clerics were thrown open to others in 1920, and the training organized by the Regius Professor, Dr. Headlam, now Bishop of Gloucester. As to the high efficacy of Oxford as a training ground for the clergy, it may be sufficient to point to the long recent series of archbishops, and to the fact that the sees of Canterbury, York, London and Durham, and the Archbishopric of Wales, are all filled to-day by her sons.

Oxford has always cherished law and produced, or harboured, eminent lawyers, chancellors and judges, or great jurists, from Vacarius and Gentilis, Blackstone and Selden, to Maine, Pollock, and Vinogradoff. A hundred years ago she could boast of Eldon and Stowell, as later of Selborne and Halsbury, or Bryce and Dicey. But they were not trained in law by her, but followed the old classical or mathematical curriculum, as did Lords Cave and Sumner and Buckmaster, and Sir John Simon, Lords Birkenhead and Sankey marking a partial transition.

To-day, thanks largely to the generosity and discernment of All Souls, the teaching of jurisprudence has been organized and implemented with four professors, four readers and four lecturers, while every College supports or shares a College tutor or lecturer. Speeches, lectures, moots and imaginary trials are arranged, and living and personal touch kept up with the Inns of Court and the Courts themselves.

Progress in Medicine.

Medicine has been even more strikingly developed, mainly by three brilliant recent Professors, Acland, Burdon-Sanderson and Osler, ably followed by Sir Archibald Garrod and now Sir Farquhar Buzzard. The faculty has established a happy co-operation with the Radcliffe Infirmary and with the large resident body of practising physicians and surgeons, while maintaining its necessary relations with the London hospitals and colleges and councils. A special diploma in opthalmology, rewarding special courses of study, is now an old-established and successful institution.

The old notion, to be read in the pages of Middlemarch, of the dissociation of the Oxford and Cambridge Degrees from practical training, is to-day so obsolete that George Eliot's allusions no doubt

prompted by George Lewes are probably hardly understood. Certain rigorists opposed all this, holding that the development of the Medical School would be inimical to the pure sciences of zoology and botany. The very opposite has proved to be the case.

So again the practical developments of physics, engineering, and electricity, and the interactions of applied chemistry, are reflected in their schools and laboratories. Oxford has become, too, the chosen home of forestry, British and Imperial, and agriculture, still wearing the old name of " Rural Economy," and agricultural engineering with its experimental farm and research institute are also active and expanding.

The adequate teaching of modern languages, attempted two centuries ago, and then allowed to lapse, is to-day an accomplished fact. On the eve of the first reform, in 1848, the university came into the possession of the noble Taylor Building and the ample Taylor Fund. But for half a century little was done. Curators, a library with a librarian, were established, a professor and teachers appointed. They " represented " the languages. It was not their fault if they could do little more. Occasional lectures were given, a few scholarships awarded to chance students, among them the poet Swinburne and a Chancellor, Lord Cave. The Fund was accumulated for a better day. At last it came, with the institution of the honour school in 1903. Students of both sexes began to flock. Teachers multiplied. To-day the ideal of a first-rate professor for each of the leading tongues, French, German, Italian, Spanish and Russian has been realized. Nor should the establishment of professorships of Modern and Byzantine Greek, of the Romance languages, and of comparative philology, be forgotten. For English the ideal had been reached a little earlier.

Music and the Arts.

Music was the fourth of the old faculties. But its study and cultivation in Oxford, like that of the drama, had fluctuated with the national taste and temper, as reflected in the academic attitude. For a time the activity and influence of Oxford was seen almost entirely in Church music. The succession of professors, Ouseley, Stainer, Parry, Parratt, and to-day Sir Hugh Allen, charts the transition and the happy conjunction with the Royal College. To-day music takes a wider, something like the widest range.

So with the Fine Arts. Sixty years ago the graduate or undergraduate could hardly see a picture in Oxford other than the old-world portraits in his College Hall. " It pitied him " to think of the " Stones of Greece " stuffed into cellars with sacred cows and oriental monstrosities. To-day the galleries in the New Ashmolean have been made some of the most beautiful for their size in Europe, while the marbles and statues of Hellas, the collections of casts, the instructive relics and records of Egypt and Assyria, are artistically and scientifically disposed ; to be illustrated by the lectures and teaching of the keepers and professors, and by a well-stocked library.

Classical Studies.

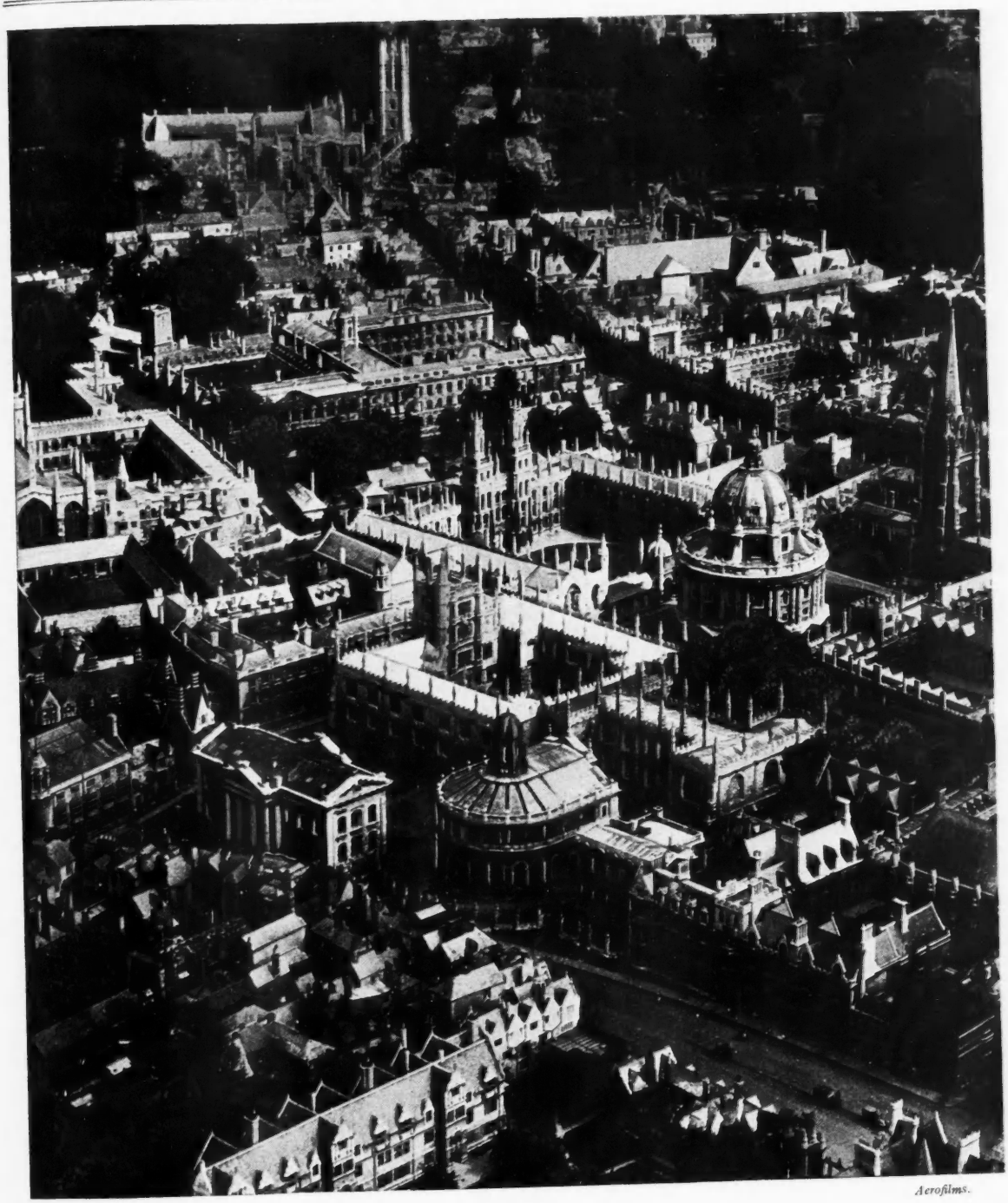
The old Greek and Latin *Literae Humaniores*, literature, philosophy and history still hold their own, strengthened and widened by the newer additions, archaeology, epigraphy, Greek Art in statue and vase, papyrology ; of these last Oxford is peculiarly the home. Few changes have had more fruitful results than the conversion of the curious old Craven Benefaction into the scholarships which supplement the famous " Ireland," and the Craven Fellowships for travel and research, working in as these do with the Schools and scholarships at Athens and Rome.

Oriental studies, again, have to-day their modern and extended recognition, with their School in Jerusalem, their diggers in Mesopotamia, their enriched and multiplied endowments.

The fame of the Oxford History School needs no emphasis. It is still undimmed, still growing.

With all these manifold cares in her own domain Oxford has many which carry her influence afield. The old " Extension Movement " for providing lectures and teaching outside Oxford continues its operations under the Delegacy for Extra-Mural Studies, and includes that most important addition of the " Tutorial Classes " which grew out of Oxford's welcome to the W.E.A. organized in 1907. The two Examination Delegacies—the " Oxford Locals," the Oxford and Cambridge Board—provide tests for the secondary schools, and for the public schools. Oxford has, too, her definitely affiliated universities and colleges, some of which, however, have partially outgrown her tutelage, at Lampeter, at Nottingham, Reading, Southampton and Exeter. The Indian Institute and Rhodes House have their own significance.

There are at Oxford innumerable occasional lectures on every sort of topic by lecturers resident or invited, specialists and celebrities of every kind. Nor should the many clubs and societies be forgotten which make up the life social, or political, intellectual, artistic, spiritual, of Oxford's community, old and young. Some are branches of outside institutions of national or even wider interest, of the League of Nations Union, of the Victoria League, of the Classical the English, and the Modern Languages Associations.



Aerofilms.

OXFORD FROM THE AIR.

"A towery city and branchy between towers."—GERARD HOPKINS.

others are indigenous, the Raleigh Club, the Oxford Arts Club, the Musical Club, and many more. Two in particular play a considerable part in the life of the undergraduate. The "Union," founded in 1823, is still a living and incomparable school of public life and oratory. The Canning and the Chatham, and others less famous, and the many College Societies, second its influence. The O.U.D.S. year by year crowns the interest in acting which, a living factor in the spacious day of Elizabeth and Shakespeare, had been later banned and driven under.

A hundred years ago there were only two forms of atheltics just beginning to be organized, rowing and cricket. To-day there are the sports proper and cross country running, the team race (reviving in spirit the torch race of Athens), football, tennis, "squash," hockey, and lacrosse; and above all, golf for both sexes and all ages.

For what, with these multifarious activities does Oxford to-day prepare her sons? For what does she not? may rather be asked. Her studies, more specialized and "vocational," are still liberal in scope and spirit. For learning and science, for education with its ever-widening and subdivided field, for vice-chancellorships, principalships and professorships, for teaching and administrative posts of every grade and sort the world over, it is hardly necessary to say, she prepares her sons and daughters. The roll of head and assistant masters and mistresses, of education committees with their staffs, supplies the evidence.

Modern Careers.

In old days Oxford men joined the army by chance. Chance even produced an Admiral, Blake. But it was not by chance that Douglas Haig entered Brasenose and passed on to Sandhurst and the Cavalry. To-day a special Delegacy supervises the training of military candidates and the O.U.O.T.C., with its air squadron just added, is an official link between the War Office and the university. The Home and Indian Civil Services, the Foreign Office and Diplomacy, the Consular and Colonial Service, the Sudan, the Tropics, for all of these Oxford furnishes recruits.

Outside and "above" all this, as some would say, are the arts and artistic professions. In painting, in architecture, in the drama, the old drama of the boards, the mechanized drama of the "cinema," graduates of Oxford will be found managing, producing, performing. Yet again there is literature, both creative and critical, both ideal and practical, poetry and prose, history and fiction. The lucrative if precarious trade of journalism, sooner or later, draws in many sons, and some daughters, of Oxford. The tradition of "Delane of *The Times*," of the other great dailies, of the weeklies and the monthlies changes but does not die. For all these Oxford seems still to afford peculiarly efficient preparation. To them may be added the still new avocation of the British Broadcasting Corporation.

Yet again outside all, like Homer's Ocean, there is the open, uncharted sea of business. Toward this many of to-day's undergraduates turn an adventurous eye. *Quocunque modo rem* is their motto. And for this it is thought, by them and by their tutors, that the latest school, that of philosophy, politics and economics, is specially adapted. Economics, in particular, is probably the study most pushed at this hour, and new appointments are being made every day, by College after College.

Endowments and Finance.

The Colleges have not stood still. There is hardly one which has not since 1850 modified and modernized its buildings. Many have added to them largely. The number of Fellows has been in many diminished, but that of scholars and exhibitioners greatly enlarged. Expansion and modernization mean, of course, money. The expenditure of the university has grown almost beyond belief. New sources of revenue had to be found. The Colleges have been brought in to assist the university by providing fellowships and emoluments for professors and officials, and also by direct taxation under which to-day they contribute on a steeply graduated scale. Lord Curzon's efforts secured the modest but useful "Endowment Fund," and now there is the large Government Grant. Fortunately the stream of spontaneous benefactions which trickled thinly and intermittently during the last century has begun to flow again generously, and from many parts of the English-speaking world.

Thus, in the short period of eighty years, within the lifetime of the older, the memory of the oldest, one of the most ancient of Europe's intellectual institutions has been completely transformed and brought up to the very latest date. The rival ideals of the reformers of 1850, Jowett's of education, and Pattison's of research, the co-operation and conciliation of College and University in the furtherance of both, have alike been largely realized.

With her ancient dignities and duties enhanced and enlarged, Imperial as well as national, cosmopolitan, too, as in her earlier time, an age-long but ageless Queen, Oxford marches to-day, with her sister Cambridge, in the van of the social, the intellectual, the spiritual progress of this most modern and ever-moving era.

Correspondence.

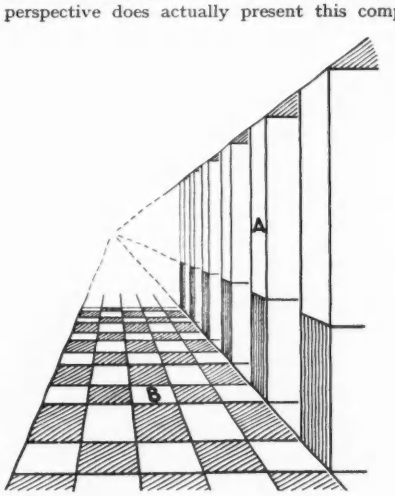
"THE TRUTH ABOUT PERSPECTIVE?"

To the Editor of DISCOVERY.

SIR,

One of the two subjects by Van Gogh, "The Yellow Chair," is surely in mathematical perspective if the view-point be taken as very near the chair and, of course, above it. In "White Roses" the artist was very near the bowl of roses also, but I think no theory can prove that the drawing of the base of the bowl is correct, assuming, that is to say, that the base is circular and not of a segmental shape rather bigger than a semi-circle. It seems to me that in the space between the horizontal diameter of the base and the angle of the wall behind there is not sufficient room for the completion of a circular shape. This, however, by the way.

One thing seriously puzzles me about Mr. Thouless' exposition in your April issue. I am wondering whether he has taken into consideration that we have two eyes. All our visual images are governed by this fact, and also by the fact that no observer can keep his eyes accurately in the one fixed spot which the mathematician assumes for his view-point. Our vision gives us a stereoscopic effect, and the artist and the mathematician have to represent this as best they can in the flat. There may therefore always be some variation between visual and mathematical perspective. Mr. Thouless deals only with horizontal planes. What about the vertical ones? If our eyes were one above the other instead of in a horizontal line, it is clear that our mental vision of horizontal planes in perspective would be a sort of compromise between the two different figures seen by each eye separately. With our eyes as they are, horizontally placed, our vision of perpendicular planes in perspective does actually present this compromise.



There is a definite relation between the horizontal and perpendicular planes, and it is this, I imagine, which accounts for the variation from the mathematical perspective noted in the article. The fact that this variation between mathematical and visual perspective exists can be shown by a diagram.

Take the simple view given herewith, of a series of square columns standing on the right of a squared pavement. This is drawn in mathematical perspective. Now visually, the face of the column A, seen by the left eye alone, would appear to be wider than it would be if seen by the right eye alone, because the right eye gets a more foreshortened view. The drawing must show only one dimension—an average between the two. In regard to the horizontal planes, the lines in the paving continue those in the columns. Consequently there must be a similar variation in the visual widths of B, as seen by each eye separately. Here, again, the drawing which is intended to represent the vision of both eyes together must show an average dimension. This, in fact, is what mathematical perspective shows, for it assumes only one eye point.

Yours faithfully,

The Priory, Orpington. C. E. HUGHES.

THE LAST OF A RACE.

To the Editor of DISCOVERY.

SIR,

As you recently published Mr. Gladstone's article on the island of Foula, Shetland, you may be interested to hear that in the island there has recently died a man known as Gideon Manson, who was probably the last person in Britain to be born without an established surname. Until a few generations ago it was the custom in most Foula families to use as surname the father's first name with the suffix "son," *e.g.*, Peterson, Robertson, etc. This makes pedigree-hunting a difficult and confusing task. For example, one may find three families—Henderson, Jamieson and Peterson—all descended from a common grandfather, who was, perhaps, known as Anderson. In this instance, Gideon was the son of James, and grandson of Magnus, and great-grandson of Robert. Consequently his father was called James Manson (*i.e.*, Magnus' son), while his grandfather was Magnus Robertson. Following this fashion of "turning the names," Gideon should have called himself Jameson; but he decided instead to adopt his father's name, Manson, as his permanent surname. Though many boast an ancient name, few can claim a surname that has been established for one generation only.

Gideon was an interesting character. He was unmarried and lived alone in a tiny cottage called Muckle-grind (meaning "big gate"). He was a fisherman, but, since the coming of the steam trawler, fish has become exceedingly scarce, and Gideon, having no craft as a second string to his bow, was reduced to extreme poverty. For years he could not pay his rent of ten shillings per annum, until the advent of the old age pension raised him to comparative opulence.

His great pastime was composing poetry. All the chief events in the life of the island were recorded in verse, often of a biting and satirical turn. He used to say that after his death the world would recognize in him a second Burns. He had, however, the greatest objection to reading or reciting his works. Now and again, when his tobacco pouch was growing lean, he might be induced to accept a bribe, and would recite one poem in return for two ounces of tobacco; but under no circumstances would he yield to demands for an encore. We were fortunate enough to hear from him a very fine and almost complete version of an old ballad called "The Cruel Mother." Such songs and ballads, recited over the peat-fire flame, are fast giving place to the gramophone and wireless; and Gideon, with his apparently inexhaustible memory, his lonely independence and reserve, belonged to a type of character that is well-nigh extinct.

Yours faithfully,

Penkaet Castle, E. Lothian. M. C. S. HOLBOURN.

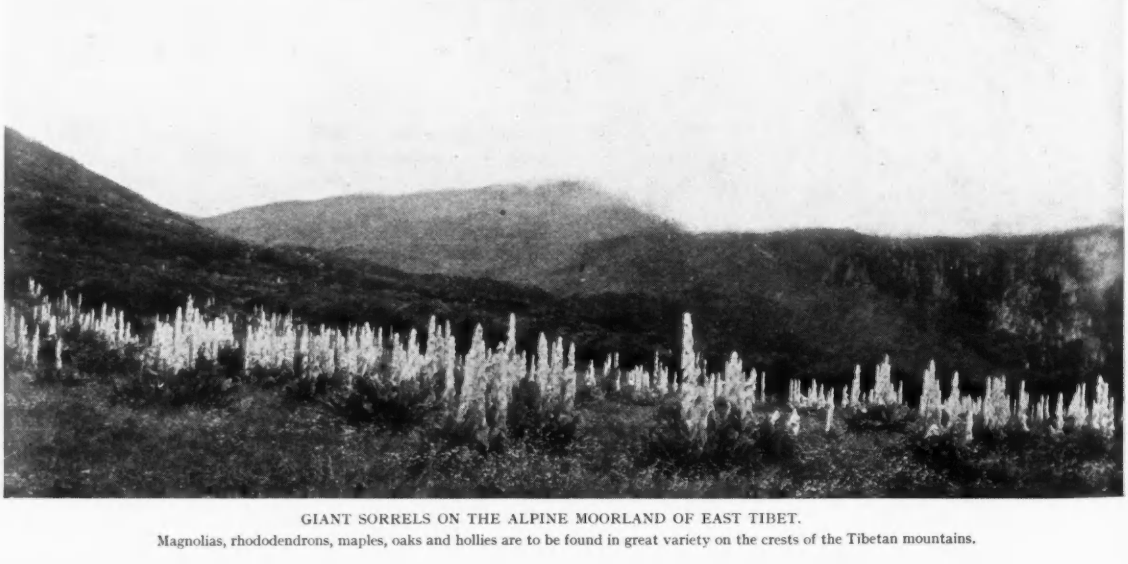
Plant Hunting in Untrodden Wastes.

By F. W. Kingdon Ward.

Captain Kingdon Ward has just been awarded a medal by the Royal Horticultural Society in recognition of his discoveries of plant life in Indo-China. He now describes his investigations and also his travels in the Mishmi Hills which he visited before joining the Kelly-Roosevelt expedition.

THE forests of Assam, where the mountains rise up to crests of snow and block the way to China and Tibet, are hidden in a wealth of superb flowering trees; incomparable magnolias, rhododendrons of every size and colour, maples, oaks, hollies, and an endless variety of flower and foliage. On the Alpine tops the flowers spin gorgeous carpets over the wind-swept slopes, where tractless forests harbour unfriendly natives, leeches and stinging insects, which make the life of the adventurous white explorer a perpetual misery.

With fifty Mishmi coolies carrying food and equipment, a companion and I plunged into this forested waste, in the hope of unearthing some of its secrets. We were beset by difficulties at every turn: the track was difficult, the weather was bad, and at the end of a month we were only a hundred and thirty miles from our starting point. Up and down over the sheer cliffs, holding on by roots and creepers, scrambling over boulders in the bed of the torrent, pushing through the reeking jungle, we advanced yard by yard. Our task was not made simpler by a sudden revolt of the Mishmis, who threatened to barricade the path with sharpened stakes of bamboo, on which our own coolies might impale themselves, if we would not agree to abandon the expedition. They refused to help us, to sell us food, or to guide us. Fortunately, some villages were more friendly than others, and, ignoring the threats of the natives, we proceeded slowly up the valley until the snowy mountains at its head came into view. A dashing river impeded progress, but the Mishmis took us over by a rope bridge, made of twisted strips of bamboo, under which we were suspended by means of a large cane ring; by hauling vigorously with our arms, and pushing with our feet, it was possible to ride safely, though far from comfortably, across. When they had deposited us bag and baggage on a narrow ledge of rock, high above the river, the Mishmis announced their intention of leaving us stranded, so I immediately went down to the river and cut the rope bridge! This greatly upset the Mishmis, but in the end they had to repair the rope and take us back to their village. A fortnight later, when peace had been declared, we made a fresh



GIANT SORRELS ON THE ALPINE MOORLAND OF EAST TIBET.
Magnolias, rhododendrons, maples, oaks and hollies are to be found in great variety on the crests of the Tibetan mountains.

BOATS THAT SAIL THROUGH THE RAPIDS OF THE MEKONG.
The rapids are almost continuous, and some of them are very dangerous. The steersman relies on a bamboo to steer clear of the rocks.

start, and we followed a hunter's path straight up the mountain, until we reached a height of 10,000 feet, where we encamped. Among a wilderness of rhododendrons, we remained for six weeks in the rain mist, and then we struggled up the ridge, through dripping forests and tangled thickets, to the alpine region. The exquisite beauty of those crowded mountains, mantled with forest, lashed by the rain, took one's breath away. At our feet lay all the jewels of Ophir in flower, starry constellations, dangling bells, tall pagoda-like towers. But many difficulties were to be met with yet; hunger when fresh supplies did not reach us, thirst when we could not find a spring on our lonely ridge, and a fortnight's storm at the end of the autumn when it should have been fine. But never did we forget that wonderful day when, first of all white men, we stood on the alpine summit in the heart of the Mishmi Hills, and gazed into the valley 10,000 feet below, and at the ruffled seas of dwarf rhododendron, spangled with primulas, at our feet, and the leagues of snow beyond.

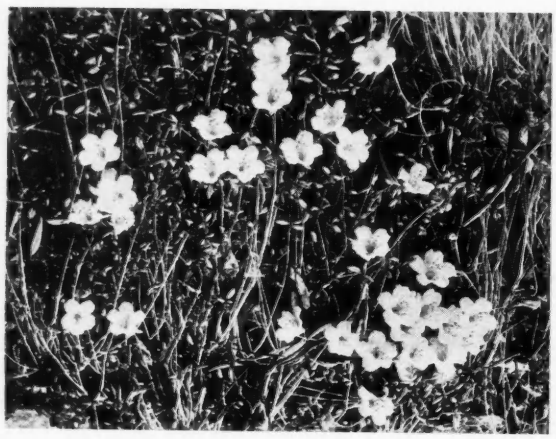
All would have been well if the Mishmis had not revolted again, and refused to carry for us. Hastily I dashed out to collect the seeds which we had come so far to gather. At the end of October I struggled up the ridge for the last time, with two faithful natives, and sleeping in a cave, spent a week collecting seed of all the finest plants we had discovered. Then we left the valley and early in November reached the British outpost on the Indian frontier whence we had started eight months before. We had had a difficult time, but we had obtained seed of fifty different rhododendrons, many of them new, besides seed of many other plants, and a number of orchids.

Plant hunting becomes an obsession. No sooner had I recovered from the strenuous expedition on the Mishmi Hills, than I was asked to join the Kelly-Rooseveldt trip through Indo-China. I was to go along through Burma and the Southern Shan States to the Province of Laos, French Indo-China, to meet the party coming in from China. From the railhead below Mandalay the road runs eastward over the hills for over five hundred miles to the frontier. Commencing as a metalled motor road, it becomes a dirt track, passable in the dry weather but impassable during the rains. We came to the Salween after three days, and crossing the river by raft, we picked up the mule road to Keng-tung, the last place in British India. It was a hundred miles to Keng-tung; and loath to abandon the lorry which had served us well so far, we started from the bottom of the Salween Gorge one hot afternoon, and after three miles we entered a road in the hills, hewn out of the rock. The road overhung the ravine, at the bottom of which roared a torrent. At the end of another mile we stuck fast.

Unloading the motor lorry, we went back to our starting point to recondition. We set out again with a lighter load next morning, and in the middle of the afternoon crossed the first high pass and began a long and dangerous descent, with hairpin bends at every ravine crossing; on one side there was the high wall of forest, on the other, a drop of three thousand feet. Negotiating one awkward corner,

we drew too close to the edge and the near front wheel went over. Our driver, with great presence of mind, stopped the car dead, with one wheel over the precipice. We had to unload the lorry gingerly, and after three hours we got it back safely on to the road. We reached the village in the valley at midnight.

At Keng-tung the lorry had to be abandoned. The track for a hundred and twenty miles over the mountains to the frontier is no more than a mule path. The direct road journey takes twelve days to the Mekong, but now I was free of the lorry and travelling leisurely, I wanted to seek orchids, up in the hills again, where the aboriginal tribes live. The hills were heavily forested to their summits, and strange orchids festooned the trees. We passed through Shan villages, and at last we reached the Mekong, and crossing by raft found ourselves in French territory. Here three empires meet: the beginning of China lay hardly a day's journey to the north, Assam was to the east, and Siam to the south. We now plunged through very wild country covered with dense forests, where on the trees grew many lovely orchids; but the jungle was almost impenetrable, and as the orchids waved from the top of great trees, they were difficult to procure.



FLOWERS ON THE MISHMI HILLS.
Rhododendron abound on the precipitous slopes at a height of twelve thousand feet.

The path on the opposite bank was execrable, and presently we were glad to take to the river bed, where, however, we found the heat intense. Gradually the path improved, and after passing through glorious jungle, we joined, on the third day, the main road between Muongsing and Hwei Sai, an important post lower down the Mekong. In the afternoon we reached Muongsing, entering the village by the market, past the white buildings of the délégation, and the fort. An Annamite of the guard indigène, dressed in khaki tunic and breeches, blue puttees and béret, with dancing pumps on his feet, attempted to arrest me for having a gun; but I told him to take me to M. Le Délégué, when all would be explained. M. Le Délégué welcomed me cordially and invited me to dinner.

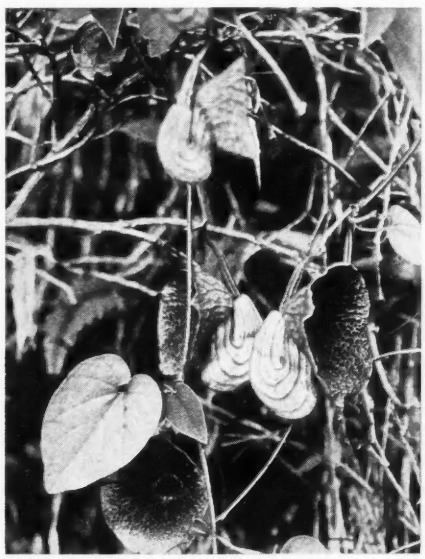
Muongsing is the last French outpost in Laos. It takes a French officer, landing in Saigon, six weeks to reach Muongsing, which is regarded as an important node, on account of the number of trade routes which converge into it. One can get almost anywhere easily from Muongsing—except to French Indo-China. Perhaps the best caravan route of all is that which goes to Keng-tung; but no trade passes this way. It is only forty miles to the British border, and only three hours to the Chinese border. Finally the Siam frontier is not many days march to the south. The obvious highway to the coast is, of course, the Mekong, only it happens to be unnavigable. Nine marches south of Muongsing is Hwei Sai, the head of boat navigation. It is odd to look down that long corridor from the ferry with the broad river shouldering its way through the sloping hills, and to know that it carries no craft. I was irresistably reminded of a fine speedway, perpetually closed by the notice "road up."

I contracted fever at Muongsing, and had to stay five weeks at this small native place. A market, famous for the number and variety of the tribes who attend it, is held every fifth day; Lao and Lu Come from the plain, Kaw, Ki and Ko from the hills, Panthay and Siamese from across the border, and many more—an indescribable riot of colour and babel of tongues. Had I not been so ill I should have enjoyed the study of these various quaint peoples. The rainy season had now begun, and travel in Laos, except by boat and raft on the rivers, became impossible. There are no roads; and even if there were, the Laotien would not travel at this season. With some difficulty we got the mule men to take us across one more range of hills to the Namtha river, a small stream flowing to the Mekong. From Mandalay was over six hundred miles by car and mule; now I had to travel six hundred more by river, before my journey finished.

It was a very lively and exhilarating trip down the Namtha river packed into light canoes, built for shooting the rapids. The rapids are almost continuous, and some of them are very dangerous. All depended on the forward steersman, who, standing on the upcurved prow armed with a bamboo, turned us off the rocks. Six days of this with constant alarms, brought us to the Mekong, where the light canoes

were dispensed with for rafts, which gave more room to turn in though they were somewhat cumbersome, and apt to behave erratically in the rapids. Alarming rapids continually break the even flow of the Mekong, and we spun round slowly, lurched over the waves, bumped and banged, and shaved rocks which threatened to split us in two. The journey lasted a fortnight, but we met with no mishap.

At last we came out through the jaws of the Namtha river into the wide Mekong. The confluence itself is tame. At the junction on the left bank stands Pakta, a sort of boating centre: and here I transferred to a raft for the voyage to Luang Prabang. Pakta, on the left bank of the Mekong, is only thirty miles below Hwei Sai, the administrative centre of Haut Mekong, the last district in Laos; Muongsing also falls within the same orbit. A number of rafts and piroques were drawn up below the high bank on which stood the bureau; and after a few formalities my luggage was transferred to a raft. The standard raft is made of two big canoes. Bundles of bamboos are lashed on either side of the raft, both as a protective measure and to add to its buoyancy. The crew numbers ten, four being steersmen, two forward and two aft, while six galleymen sit under the forward awning, though they are only called upon to do serious work when perils gather round. In the quiet reaches between rapids they go to sleep or dip their oars idly and mechanically into the water and lift them out again.



ARISTOLOCHNIA IN FLOWER.

This unusual foliage, which closely resembles a saxophone, clings to small trees and larger flowers.

The Mekong is one of the most extraordinary rivers in Asia, matched only by its neighbour, the Salween. Although not less than 2,500 miles in length, its course becomes more and more erratic as it approaches the China Sea, and within 350 miles of its mouth occurs the biggest fall in an almost continuous series of rapids. Between Pakta and Vientiane, a distance of 450 miles, the bed of the Mekong may be likened to a gigantic stairway with long treads of smooth water and short risers of furious rapids. From Pakta we proceeded to Prabang, where I went ashore to call upon the Chef du Provence, who was entertaining me.

There was still the river journey 290 miles to Vientiane, but at the latter important town I was able to take the Governor's launch to Savenakhet, a distance of 254 miles.

Vientiane, the capital of the Protectorate, is a beautiful town. It is regarded as on the fringes of civilization, and has a considerable French population. There are many delightful houses, and a number of old temples, salvaged from the jungle and cared for by the French, though disfigured by telegraph and electric light standards. Away from the residential quarter and the bazaar, however, it is a typical Laotien village. The only public conveyances are the riksha and the lorry-bus; but most of the French residents keep cars.

The Governor put an empty house at my disposal and lent his launch for the last part of the river journey, though there is a weekly ferry service to Savanakhet. Had it been the dry season, my obvious route to the coast was across the Mekong into Siam, and thence some few days' journey over the plan to the railway, by which Bangkok is quickly reached. But at this season the plain was a swamp, though not such a swamp as to be navigable by boat. The journey from Vientiane to Savanakhet took us two and a half days, steaming in the launch from sunrise to sunset. On the second evening we reached Thakhet, a fair-sized town destined some day to be of much greater importance. For it is here that the new railway from the coast will reach the Mekong and Laos. Construction has already been begun from Vinh, the seaport in Annam, but it will be some years before this 150 miles of line over the mountains can be ready for traffic. The French are clever railway engineers, and they have embarked on an ambitious scheme of railway development in their great eastern Protectorate.

At Savanakhet I said good-bye to the Mekong, and left the same afternoon for Hué, where I joined Mr. Coolidge's party. From Tourane we took steamer to Saigon, where we met Colonel Theodore Roosevelt; and what was left of the three parties were at last united only to disperse a few days later. The expedition was over.

The Unexplored Caves of Slovenia.

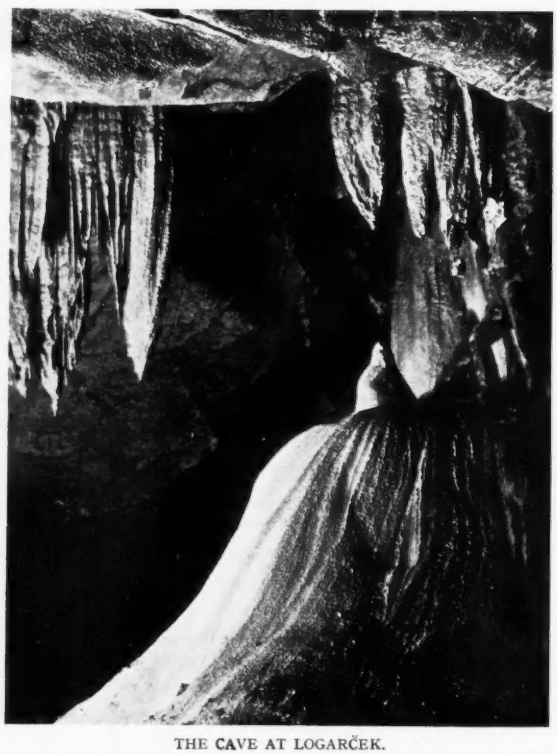
By F. S. Copeland and L. Kuscar.

It is estimated that the Kras country of Slovenia contains at least three thousand limestone caves, and although the Cave Research Society of Ljubljana has recently conducted extensive exploration work, the majority of the caves have still to be explored. Mrs. Copeland is English lecturer at the University of Ljubljana.

SLOVENIA, which forms the north-west province of Jugoslavia and projects like a wedge between Italy and Austria, is a very beautiful and reasonably accessible, if at present little known, region in Central Europe. Most of it is Alpine territory, traversed by the eastern spurs of the great limestone Alps of Central Europe. Slovenia is subdivided into Carniola, Styria, and the Jugoslav territory beyond the Drava and Mura Rivers. In Carniola one can distinguish between the purely Alpine region of Upper Carniola, the undulated forest and wine country of Lower Carniola, and the territory known as Inner Carniola, which belongs geologically to the vast limestone region extending from the neighbourhood of Trieste in the north-west to the borders of Montenegro in the south-east. This region is most widely known by its Italian name of *Carso*. The Germans call it *Karst*, while the native population, which is Jugoslav from end to end, calls it *Kras*, applying the term to that type of country wherever it may occur.

Undoubtedly, the caves of the Kras are its most interesting and romantic feature. The vast limestone grottos of *Postumia*—the German *Adelsberg* and Slovene *Postojna*—form the largest cave system so far explored in the Kras and are a very impressive sight. It may not be generally known that the Kras country of Jugoslav Slovenia contains at a low estimate some 3,000 limestone caves, by far the greater number of which have not yet been explored, and that the Kras further south, towards Dalmatia, is practically virgin ground as regards scientific investigation.

In the Kras region hundreds of openings are known, and certainly there are still hundreds undiscovered in the maze of forest that covers the greater part of the land. For a number of years past, the Cave Research Society of Ljubljana has been doing useful work in locating, exploring and mapping out the caves of this district. Biology, palaeology and morphology have much to gain from the study of cave fauna. Topographic, hydrographic and meteorological observations are of immediate practical value. During the war the caves of Inner Carniola were invaluable to the defenders of the frontier as shelters and, perhaps even more so, as places where water was to be found. For upon the surface the Kras is a thirsty land.

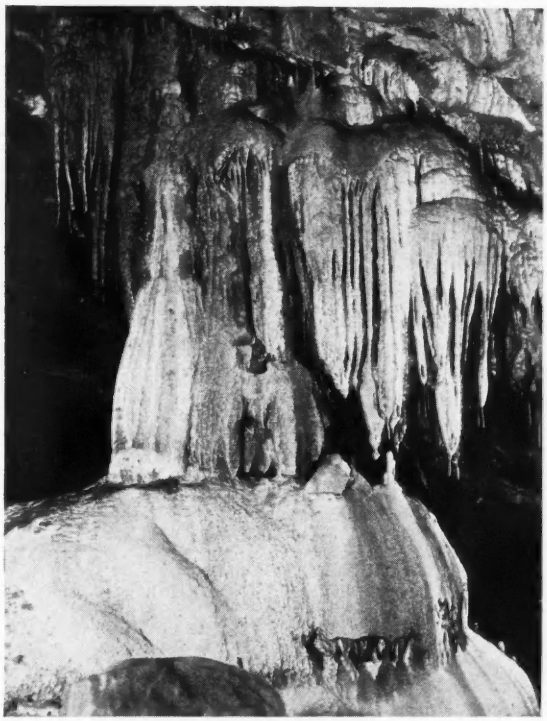


THE CAVE AT LOGARČEK.

Many of the Slovenian caves are full of the most exquisite limestone formations, perfectly formed and delicately tinted.

Most of the caves of Slovenia were formed by the River Ljubljanica and its tributaries during the early stages of its career. When we first meet this adventurous river it is none other than the *Piuca* (Pivka) which fretted out the vast grottos near Postumia. From these caves the river emerges on the Jugoslav side of the hill as the *Unec* which makes but a short appearance, babbling for a mile or so through the lush green, forest-ringed valley of Planina and then diving out of sight into the opposite range of hills. It is there that the members of the Cave Research Society,

Drs. Kenk, Rus, Seliškar, and Messrs. Mihler, Tavčar and Kunaver, with their brother enthusiasts and young assistants, have done most of their valuable work and undertaken many a descent as thrilling and as perilous as the first ascents of any Alpine crag. The caveman's climbing kit is more complicated than that of the mountaineer; the perpendicular shafts which are often the only entrance to a cave must be negotiated with rope and wire ladder. A stout spring-hook (or *karabiner*) at his belt enables the climber to attach himself to any rung of his ladder whenever he needs a rest. A mountaineer's pick proves useful over the rocks and screes below. All the time, even over the most difficult ground, the caveman has to carry his acetylene lamp. Unlike the cragsman, he never knows what awaits him until he is close upon it, be it scree, chasm, treacherous bank of clay, or icy, unfathomed water lurking in the darkness.



LOGARČEK.

This cave has been extensively explored by the Cave Research Society, by permission of which these photographs are reproduced.

Even the investigation of a small cave is the work of several hours. The altitude, the depth below the surface, and the air and water temperatures, all have to be carefully measured. Photographs are taken; ground plan and profile are drawn; animals—the tiny, frequently defective cave fauna—are collected in order to compare them with the denizens of other caves; and traps are set which will be examined on the occasion of at least one more visit.

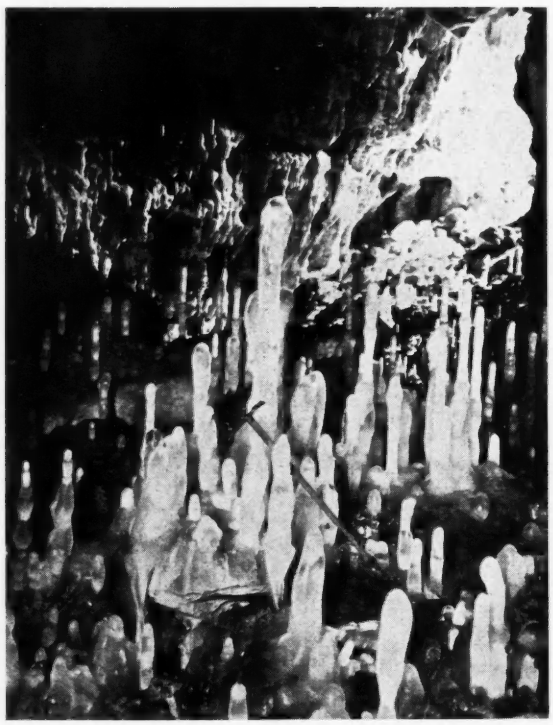
The Cave Research Society was recently requested to investigate a newly-discovered cave near Grosuplje (about an hour by train from Ljubljana) in Lower Carniola. It turned out to be a large grotto consisting of three "halls" filled with a wealth of limestone formations of exceptional beauty and perfection. The mayor of the little village of *Ponova vas* had come upon it while exploring an unpromising-looking hole which proved to be the entrance to the cave. Much interesting biological material was collected, the usual scientific data were compiled, and in honour of its discoverer the cave was named *Županova jama*, the Mayor's Cave. But no sooner was this done than the enterprising village autocrat took steps to turn his find to practical use. The cave was systematically converted into a public show place, and has proved a remunerative attraction ever since. Several interesting features were lost in this process, especially the delicate crust of lime which originally covered the entire floor, even the clay pans, with a film like thin ice, and was thickly planted with pretty little stalagmites like great mushrooms. Many of these were carried off by chance visitors, before the mayor had the entrance closed up with a stout door of which he keeps the key. The Županova jama is exceptionally rich in biological material and fauna, neither of which can be disturbed by tourists, fortunately.

That is the worst of it! Every readily accessible cave has long ago been despoiled of all removable limestone formations. Stalactites and stalagmites from everywhere near the present frontier have gone, largely in order to be disposed of as souvenirs from the Postumia grottos. A fine, large cave which has suffered badly from depredations is the Mačkovica (Cat Cave) near Planina, which, as I remember, possesses a very beautiful circular lake.

If an expedition of the Cave Research Society now comes upon an unusually fine limestone grotto, and the cave is at all accessible without special appliances, the members make the necessary observations, the bearings of the opening are carefully taken, and then the entrance is blocked and concealed. Without rope and lever the cave cannot be re-opened, and its subterranean treasures are safe. I know of such a cave, which, though small, is full of the most exquisite limestone formations, perfectly formed and delicately

tinted. A very beautiful and interesting cave, but as yet imperfectly explored, is the *Krizna jama* (Cross Cave) near Cerknica. It has been penetrated to a distance of one kilometre and a half and contains, besides the usual cave features, much palaeontological material. Cave bear remains from the Križna jama are to be seen in the Vienna Natural History Museum and in the Ljubljana Museum. Near Kočevje, the old German settlement in Lower Carniola, there are several attractive caves. One of them is an ice cave, 201 metres in depth.

There is an interesting pair of caves near the point where the River Unec (afterwards Ljubljanica) disappears from Planina Valley. Through an opening in the hillside we went down to a cave pool. A long dank passage led, apparently, to the end of the cave. Through a small gap, we could see by the light of our lanterns, a sheer drop into darkness. The chasm was just passable at the head, and on the far side there was hand and foothold which enabled us to make a descent. We were then in a second and far loftier cave which ultimately expanded into a great vault opening out into an enormous *dolina* in the forest, at a point considerably below the opening of the first cave. The two caves are known as the *Mrzla jama* (Cold Cave) and *Vranja jama* (Crows' Cave), and the connexion between the two was discovered accidentally. An animal—a fox, I believe—ran to what had been looked upon as a dead wall at the head of Vranja jama, scuttled up it and escaped through the upper cave. The waters in these caves are interesting because they contain ordinary fresh-water fish brought down by the Unec, as well as the true cave amphibia, *proteus anguinus* and *troglocaris*. I was lucky enough to get a glimpse of all three. The *dolina* outside Vranja jama was gay with spring flowers and delicate ferns at the time, and every stem, leaf and blossom turned sharply away from the gloom of the cavern towards the warmth and light of the sunshine without.



AN ICE CAVE NEAR GROSUPLJE.

Investigation in this cave revealed a wealth of ice formations of exceptional beauty and perfection.

Two of the largest and most difficult caves so far tackled in Inner Carniola are the *Gradišnica* and the *Logarček* (Little Woodman. But why?), both in the wooded region near Vrhnika. The entrance shaft of the Gradišnica is a sheer drop of 100 metres. The explorers let themselves down by a pulley. At the bottom of the shaft a steeply inclined passage led down to a second 40 metre shaft. They then came to a vast hall, about 200 metres in diameter, lined with clay and containing fine limestone formations. Then followed another descent, and at the end of that a syphon, fairly near the subterranean course of the Unec-Ljubljanica. This river contains no cave denizens. Unfortunately, the Gradišnica is very difficult of access; would-be explorers must be technical experts in cave climbing, and have all the necessary appliances at their disposal as well, including a collapsible boat, which the Cave Research Society has long needed and only just acquired. The Gradinišca is the *deepest* of the Slovene caves so far visited, the exploring party reaching a depth of 230 metres below the entrance. Most of the shafts in the Unec-Ljubljanica territory average 100 metres in depth, more or less.

First favourite with our cavemen is the *Logarček*. The cave is entered by a perpendicular 30-metre shaft where rope and ladder are indispensable. Broken ground leads to a second 30-metre shaft at the bottom of which the cave branches north and south. The northern gallery has been explored for a length of two kilometres and has proved rich in scientific material. There are great "halls," long passages and exceedingly difficult traverses where the explorer has to skirt precipices and edge his way along the top of treacherous banks of clammy, bottomless clay.

The southern gallery of the cave is rich in beautiful limestone formations and cave pools, and ends in a precipice that has not yet been descended.

Cave springs are obviously valuable in a region where surface water is scarce. Hydrographic observations form an interesting and immediately useful part of the cave explorer's work. Only by studying cave waters can the subterranean courses of rivers or springs be traced and determined. One of the methods practised is to discharge colouring matter (uranine or fluorescine) into the water to be followed up. A watch is set or the public in general is requested to look out in likely places for the reappearance of the tinted water. Another exceedingly important feature of cave exploration is the study and collection of cave fauna. That is strange hunting! The largest of the creatures are scarcely bigger than a mouse, and these giants, a species of *chiroptera* (bats) are not true cave animals but merely lodgers. Yet in many cases it is these lodgers who provide the means of subsistence for the natives. Clinging to the roofs of caves after the arduous flight abroad, these bats digest their huge meal of insects caught out of doors, till their droppings form regular hillocks on the floor below. These droppings of bats form the staple food of the cave animalculae, together with such organic substances in decay, animal or vegetable, as may be about. Another item on the menu is provided by sundry saprophytic plants, including fungi, which exhibit all manner of freak development in this world of eternal darkness.

GOING DOWN THE LADDER.

The perpendicular shafts which are often the only entrance to the caves must be negotiated with the utmost skill.

The most interesting among cave denizens are, of course, those which never see the sunlight and are therefore specially adapted for life in darkness. The best known of them is the *proteus anguinus*, or *hypochthon*, which occurs throughout the Kras, from Hercegovina to the neighbourhood of Trieste. When the subterraneous waters rise in time of heavy rains, the *proteus* is swept out of his regular habitat and left stranded in pools where he is easily caught.

These floods also wash up quantities of cave sand containing cave snails. Some of them are water snails, and some land snails which have found a watery grave. The snail species are differentiated according to the shape and character of the shell, so that the zoologist is often satisfied if he can but collect the dead shells. Then there are the cave spiders and cave beetles. All cave creatures are without pigment; the beetles only appear light brown because of the colour of their chitinous skeleton. Subterranean animals afford excellent examples of the reduction or suppression of organs not in use, and the correspondingly high development of others. All true troglobia are blind. In the eternal darkness of their world, eyes would be of no practical use, so they have developed feeler hairs, and the inordinate length of leg and antennae bears witness to the keen development of the all-important sense of touch.

An aquatic animal, perhaps the prettiest of the cave-dwellers, is the *troglocaris Schmidti*, a swimming crayfish, very graceful and swift. His nearest relation is the common shrimp.

The collecting and collating of zoological specimens in caves is of great biological interest. Each system of caves is a world by itself. Incidentally, the careful study of cave animals is a great help towards determining the source and progress of waters underground. The great Kras district between Slovenia and Hercegovina is still all but unexplored as regards zoological research.

Anyone desiring detailed information in regard to this subject, or perhaps contemplating a visit, would do well to write to The Secretary, Drustvo za raziskovanje jam, Univerza, Ljubljana, Jugoslavia.

On the Tracks of the Gorilla.

Dr. Bingham's Report.

It will be recalled that, last year, the Belgian Government granted the joint request of the Carnegie Institution of Washington and of Yale University to study the habits of the mountain gorilla in the sanctuary established for the animal in the Belgian Congo. Dr. Harold Bingham and his wife, who set out for the sanctuary last June, have now returned with an interesting account of their investigations.

For several years Professor R. M. Yerkes, of the Institute of Human Relations, Yale University, has been engaged in the study of primates, an order of mammals which includes man and the apes. At the outset of his research, some colonies of chimpanzees were assembled and studied in Cuba and at the University. Since this initial work, reported in *Discovery* last June, an announcement has been made that Yale University, through the assistance of the Rockefeller Foundation, has acquired nearly two hundred acres of land in Florida where Professor Yerkes will establish a station for the breeding and scientific study of anthropoid apes. In the capacity of Research Associate, Dr. Bingham has been closely associated with Professor Yerkes in these investigations.

"PARC NATIONAL ALBERT."
Free-living gorillas in the sanctuary established for them in the Belgian Congo by King Albert.

Dr. Bingham's new study of gorilla behaviour in *Parc National Albert*, Belgian Congo, was therefore in part supplementary to the researches begun in the Yale laboratory. Indeed, the expedition was undertaken not only to obtain authoritative information about the behaviour of free-living gorillas, but also to investigate the feasibility of co-ordinating such observations with lines of anthropoid research already established at Yale and with the programme contemplated for the anthropoid station to be established in Florida.

Dr. and Mrs. Bingham sailed from New York on 7th June, and landed at Dar es Salaam on the African coast on 23rd July. From this point they proceeded by train, boat, and motor transport to Rutshuru, about thirty-seven and a half miles north of Lake Kivu and three days distant from "Akeley Camp," their objective in the Parc, which marks the last resting place of Carl Akeley, the explorer, through whose initiative the sanctuary for wild life was established in the Belgian Congo. At Rutshuru they were received by the Parc officials, who provided them with comfortable living quarters and helped them to secure competent guides and porters and to make the final preparations for their observational work. In describing this part of the trip Dr. Bingham said: "Life was strenuous for us in Dar es Salaam and Kigoma—but not more strenuous than the preparations in America and Europe. Motor service from Uvira to Costermansville (formerly Bukavu) and from Kisenyi to Rutshuru is surprisingly modern. Much of the road from Lake Tanganyika to Lake Kivu is hard surfaced. Between two and three thousand natives are occupied in extending the road and keeping it in repair. So rapidly are industrial changes being made in this part of Africa that we required only four hours to go from lake to lake; whereas a decade before the Akeley-Bradley expedition, while covering the distance in record time, required eight days by porter safari.

"At Costermansville we found the New York expedition (joint expedition of American Museum of Natural History of New York and Columbia University). We stayed there a week at a comfortable hotel managed by a capable English family. This was the last hotel we saw for three months. We put on our hobnails and bush jackets, employed our first native boy, and began to prepare for the mountain work that was soon to follow. From Costermansville we went to Kisenyi on freight boats and barges. This was perhaps the hardest part of the journey. The small barges were loaded with various kinds of

freight and swarmed with native workers. There were no sleeping accommodations, and there was very little protection from the sun. No meals were served. Freight service over Lake Kivu does not yet permit a fixed schedule. The captain calls at those ports where freight is to be received or delivered and lands in the evening for the convenience of the passengers. The first night, 6th August, we landed at Kehehe to sleep and eat. An unscheduled landing on the 7th, due to heavy winds, delayed our arrival at Kisenyi until the following day. This illustrates the uncertainty of travel over Lake Kivu at the present time. There is a passenger and mail boat, but unfortunately it carries no heavy baggage. We could have chartered this little boat and proceeded quite comfortably to Kisenyi if we had been equipped with sleeping and eating facilities, but we had learned from experience to take no chances on being separated from our own baggage and food.

" Arriving at Kisenyi, on 8th August, we established camp and began the selection of our personal boys, securing three during the week. Progress with the Swahili language became more rapid when we had to make our wants known to the boys in their own tongue. None of them could understand French or English. On the 17th we reached Rutshuru, the headquarters of Parc officials, and, greatly to our surprise as well as delight, found a house surrounded by tropical gardens awaiting us. We were told that it was ours while we were there, and that we might take the key with us when working in the gorilla sanctuary, leaving behind supplies that we would not need in camp. Following the advice of the Administrator at Rutshuru, and the Conservateur of the Parc, we made Lulenga the base for our field supplies. Meanwhile I had called on the White Fathers at Lulenga Mission in company with M. Hemmeleers, Conservateur of the Parc, by whom we were received most cordially. The Administrator, M. Dubuisson, had made official arrangements at Lulenga for our porters, storage of our supplies, *posho* (banana beer) for the porters, and for our personal accommodations in their guest house. Many of the successes which we experienced are due to the generous aid of Fathers Provost and Van den Houdt of the Mission. Through the latter, especially, our practical arrangements were completed for three separate porter safaris which started from Lulenga as a base."

A TYPICAL ATTITUDE.

One of the band of gorillas which the author was following is seen crouching on the trunk of a fallen tree.

GORILLA'S NEST.

The gorilla's simple house is usually made by pulling and breaking down plants and vines within reach.

On 26th August Dr. and Mrs. Bingham with native guides, gun bearers, personal boys and forty porters left Lulenga for the three days' climb up the wooded slopes of Mount Mikeno to Kabara, where they established their first field camp. It was to this spot that Akeley returned in 1926 for the purpose of exploring the reserve, and of securing accessories and background for the gorilla group which he was preparing for African Hall in the American Museum of Natural History of New York, and it was here that the explorer died. The camp established by Dr. and Mrs. Bingham was set up within sight of Akeley's grave, and here the expedition remained for the first month of work. During the period they were in frequent contact with various gorilla groups, following them as they fed their way along, carefully recording, for future study, observations on the nests, the feeding habits, the social responses, the nomadic behaviour, and the individual traits

of the animals. They took moving and still pictures whenever conditions were favourable.

A belt of forest growth of varying width, in which the bamboo predominates, encircles the central mass of the three great volcanoes of the Kivu region—Mikeno, Karisimbi, and Visoke—at an altitude of from about 7,500 to 10,000 feet. In places it is so dense that it is impossible for one to penetrate it except by cutting trails. It is in the bamboo belt, and for a considerable distance above it, that the gorilla ranges in his search for food. The succulent shoots, the "suckers," which the bamboo roots send through the soil into the air above, constitute an important item in his bill of fare. The young and tender shoots are eaten entire; the older and tougher stalks are torn open and only the inner portion selected. Wild celery is another growth that the gorilla apparently finds appetizing. This plant, which attains a height of six or eight feet, grows luxuriantly over extensive areas. The stalks are thick and filled with water, and the young shoots are crisp and crush or break readily. In feeding, the gorillas pull the stalks out of the ground and eat the tender roots and inner and lower stalks. Mrs. Akeley, who with her husband followed bands of gorillas in this section, says expressively: "When the gorillas have finished their meal, the 'celery patch' looks something like a field of young corn after hungry cattle have had their fill." That the gorilla, however, is not limited in his diet to bamboo shoots and wild celery, but that he feeds upon other plant varieties, is a conclusion which Dr. and Mrs. Bingham found much evidence to support. They gave particular attention to the growths upon which the gorilla feeds, and brought back a number of such plant specimens for examination and identification.

THE GRAVE OF CARL AKELEY.
It was this American explorer's initiative which led to the establishment of the sanctuary for gorillas.

It seems to be quite evident that gorilla bands are continually moving, though in a leisurely manner. Apparently they have no abiding place, but constantly wander about as the lure of food impels them, though, of course, their movements are limited to the zone in which they find conditions most suitable. There are indications that they sleep but one night in a given "nest," which is a very simple affair, usually made by pulling and breaking down the plants and vines which chance to be at hand. Some reports which reached Dr. and Mrs. Bingham indicated that these animals frequently built their nests in trees; others reported that the nests in the region were never built off the ground. While, in general, it seems improbable that the great weight of the fully grown gorilla's body permits him to spend much time in trees, nevertheless, from the evidence secured it is believed that the varying physical conditions in the areas over which the gorillas range may lead to important differences in feeding and nesting habits. It is probable, too, that changes in climate, in seasons, in rainfall, in temperature, possibly also changes in air currents, may affect the behaviour of these animals, resulting in significant environmental adaptations.

For nearly a month the observational work of the expedition was carried on in altitudes above the bamboo belt. A similar period was later devoted to exploration from three different field camps on the slopes of Mikeno in and below the bamboo belt. At these lower altitudes they found tree nests of the gorillas, sometimes as high as fifty feet above the ground; and, east and west of Berunga, old nests made by chimpanzees. Both above and below the bamboos they observed gorillas and trailed various bands for distances varying from one to three days of gorilla travel. During these studies the party practically girdled Mount Mikeno, and Karisimbi at altitudes ranging from 6,000 to 12,000 feet. On 11th October they struck camp, returning to Rutshuru where a few days were spent in trailing buffalo and elephants in order to compare the activities of these animals at lower altitudes with their activities on the slopes of the volcanoes. On 29th October, the explorers turned their faces homeward.

With all true research workers, study of a problem always raises innumerable queries not before thought of, and Dr. and Mrs. Bingham were no exception. While they obtained valuable information about the behaviour of these great apes, they returned with many fresh questions relating to behavioural adaptations, questions that cannot be answered with assurance without further study and observation.

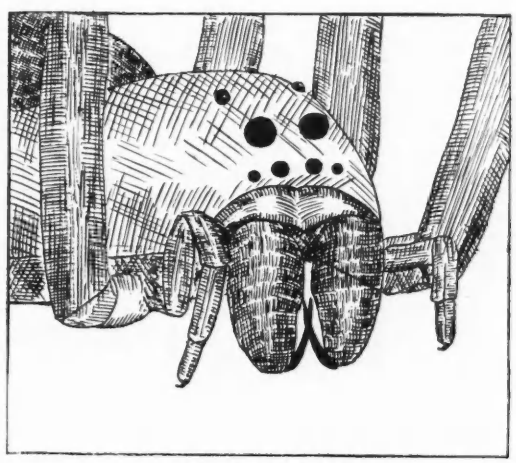
How Wolf-Spiders Behave.

By Theodore H. Savory, M.A.

The habits of spiders are so imperfectly known that new features are certain to be observed by anyone who keeps and watches them. Some recent results on the life of the wolf-spider are here described.

THE acquisition of a kitchen garden affords one an opportunity for learning much more than the persistence of couch-grass or the best soil for broccoli; it gives one a good chance of studying the wolf-spiders that abound during the gardener's most active season. This family, the *Lycosidae*, cannot complain of neglect in the past. Their courtship antics have been the subject of several observations, and their characteristic habit of carrying their cocoons fixed to their spinnerets has been used as a test for their powers of remembering; the original Tarantula was also a wolf-spider. Other details remain but partially known.

The most abundant wolf-spiders belong to the genus *Lycosa*; *L. amentata* is the commonest in our gardens, while *L. lugubris* and *L. pullata* are found in woods and fields. Although all these spiders are wanderers, they will live in cages so long as they are given sufficient to eat and drink. Their cages need not be elaborate, and an empty jam-pot is as good as anything. It may be left open as these spiders cannot climb much. The food may be small spiders or any kind of insect, though ants are not usually acceptable. A hungry wolf-spider must be a formidable antagonist for any small creature that may be so unlucky as to come in sight, for it is vigorous in attack and tenacious in pursuit. I have seen a spider leap upon its prey with such energy that it rolled completely over, administered the fatal bite while still lying on its back, and then struggled to its feet again; and I have caught spiders in the field carrying in their jaws insects which have lost their legs or wings or even their heads, evidence of the ferocity of the attack. When one is keeping a number of wolf-spiders, it is convenient to be able to feed them on each other's young. In this connexion it is particularly interesting to observe that if one of a wolf-spider's own family be taken from her back and driven into her sight, she may rush forward and seize it, but she does not eat it or even harm it. She at once drops her offspring, which probably finds its way to her back again.



WHAT THE VICTIM SEES.

Spider's head as it appears to its prey. A hungry wolf-spider is a formidable antagonist for any small creature.

In natural circumstances, wolf-spiders undoubtedly drink rain and dewdrops, and in cages they should be given water at least once a day in hot weather. If a drop falls with a splash near a thirsty spider, it runs forward at once and begins to drink. If a drop is very carefully lowered to the cage floor close to the spider, there is at first no reaction. But after an interval which agrees astonishingly closely with the (calculated) time required for the water-vapour to diffuse across the intervening space, movements of the spider's palpi are seen, and the spider moves forward and sucks up the water. This is a good example of hydrotropism, or turning towards water.

Wolf-spiders, like all others, constantly preen themselves, combing their legs one against another and passing them through their jaws. There is little doubt that this anoints the leg with a secretion from the maxillary glands inside the mouth. It is usually said that this prevents a spider from being caught in its own web, but such a statement is meaningless when the spider does not spin. It is apparent that a spider's leg, an active and versatile organ, will function efficiently only if lubricated in this curious way. I have often had to anaesthetize a spider with chloroform or ether, and have noticed that if either of these fluids comes into contact with a leg, the spider on recovery preens it very thoroughly, as if all the secretion had been removed by the solvent action of the anaesthetic.

An allied action is seen when the spider has cast a leg. It has lately been

discovered that this familiar antotomy is not, in arachnids, the reflex action it was formerly supposed to be. The spider seizes a crushed or injured leg in its jaws and pulls it off, the limb parting naturally at the weak spot between the first joint or coxa and the second or trochanter. It then puts its palpi into its mouth and applies the moistened end to the scar several times in succession. Perhaps the clotting of the blood is assisted by this means.

The life-histories of many spiders are complete within a year. The spider hatches in the spring, matures in the autumn, and dies in the winter. Wolf-spiders are not like this, and their habit of carrying their cocoons at their spinnerets and their young on their backs, makes it easier to determine the general programme of the wolf-spider's life. In normal circumstances the first cocoons appear about the middle of May, and are carried by the spiders at their spinnerets for five weeks. The young then emerge and mount upon their mother's back, where they remain for about a week. Less than a fortnight after they have dispersed, that is to say, before the middle of July, the second cocoon appears and usually hatches before the middle of August. By the middle of September mature specimens are scarce, though I have caught a female with a small cocoon, probably her third, as late as 22nd September. One caged spider laid her third cocoon on 4th October but ate it the next day. After the beginning of July mature males are very rare, but occasionally one is seen towards the end of September. These autumn males are probably the offspring of the May cocoon, whose successful career has resulted in a precocious development. The majority of their kind are a little more than half-grown at this time and disappear from sight in October.

Hibernation.

In reality they are hidden away in cracks and crevices and under fallen leaves, and so hibernate during the winter. The lower temperature provokes their thigmotropic habits, which impel them to force themselves into situations where a large area of the body is in contact with solid objects. I have made deliberate use of this tropism by concealing crumpled pieces of paper in suitable places, and visiting them later to shake out the spiders that have lodged within the folds. It is a sound principle to adopt any bait or trap to the tropisms of the creature that is sought.

The escape of the young wolf-spiders from the cocoon is one of the most interesting sights that a spider provides. The cocoon is still carried at the spinnerets, but it has burst open a little at the equator and the young struggle out one by one. They are evidently guided by an unerring instinct, as they climb over the top of the cocoon on to their mother's back and move forwards. The first two take up their positions one on each shoulder; those that follow cling just behind until the whole space is thickly covered. The empty egg-bag is dropped some time after it is quite emptied. It should not be thought that before this event the cocoon is carried with unbroken continuity. A spider may be seen to move it momentarily as occasion requires for her personal convenience, holding it in her fourth pair of legs before replacing it. At other times, she grasps it in her legs and turns it about, while adding more silk to the outside. The wolf-spiders belonging to the genus *Pirata*, which live by ponds and upon the water surface, spin themselves silk tubes in which they make a more or less permanent home. I have seen them in the evening lay aside their cocoons and move slowly and deliberately about the cage, the abdomen swaying and the spinnerets diverging, exactly like a house-spider. After a time they cease to spin and then they pick up their cocoons once more.

A Fascinating Study.

Of all wolf-spiders, those of the genus *Pirata* are the most fascinating. They should be kept in a tilted jam-pot, with half the bottom covered with water. Then they live and spin their tubes on the dry upper half, and come sculling about on the water in search of food. They can hunt by sight, like other wolf-spiders, and they can hunt by vibration, like web-spiders, only they use the ripples of the water to guide them to their prey. The spider's usual position of rest is to stand in the mouth of her silk tube with her forelegs extended upon the water's surface. An insect dropped upon the water at once provokes her to rush out, and just as web-spiders will rush out to a tuning fork placed on their webs, so will *Pirata* run out to a tuning fork whose tip just touches the surface of the water. Thus they combine the habits of two essentially distinct kinds of spider, for they exhibit the vibrotropism of the web-spinning species.

Almost immediately, wolf-spiders will be appearing again, and opportunities for further research will occur. Observers can hope for interesting results even if they confine themselves to the ordinary processes of feeding, drinking, moulting, and cocoon making. In particular, a comparison of the reactions and habits of different species would be welcome. Species are as often distinguished by their behaviour as by their structure, and much has yet to be learnt in this respect.

Genetical Methods of Livestock Improvement.

By F. A. E. Crew, M.D., D.Sc., Ph.D.

Animal Breeding Research Department, University of Edinburgh.

The following are extracts from Professor Crew's lecture last month to the Royal Society of Arts, at a meeting presided over by Sir Daniel Hall. After defining the relation of breeding and economic factors, the author indicates the scientific lines on which progress should be made in livestock improvement.

At one time, tradition bequeathed by one generation to another was sufficient to command success in livestock breeding, but discoveries in fields of knowledge seemingly quite remote from farming have made the breeder largely dependent upon information that cannot be acquired on the farm. Nowadays tradition must ever be reviewed and commonly discarded. Advances in our knowledge of the principles of breeding, which are the substance of the science of genetics, have been such that to-day the actual value of a particular system of breeding is to be assessed only by one versed in genetical science. No breeder can afford, even if he would, to neglect developments in this science, for progress in the techniques of breeding would seem to be possible only through the disclosure of relevant knowledge, through scientific investigation, and through the democratization of this knowledge. But livestock breeding is much more than an adventure in applied genetics. The breeder is primarily a manager of a very complicated business, and it is expected of him that he shall be able to construct his own policy of breeding, to check the costs of production against the prices that he is likely to receive, and to organize the application of labour. He must, moreover, be a man of live imagination, possessing the ability to anticipate trends of development, and to be alive to the values of the contributions that science has made and is making and to the power that it is placing in his hands.

The Real Test.

It is far too commonly forgotten that science is of assistance to the breeder only if he knows already the primary business of farming. It can be of help only if he is competent to apply its generalizations to his own particular circumstances. Science can contribute nothing unless the breeder is at all times prepared to jettison the old and to accept the new, to regard no method or system as immutable. It must be understood that no particular method is good in itself, but only in relation to prevailing conditions of markets, climate, soil, and so forth, and that the only real test of the value of a method or a policy in breeding, is that it shall yield a profit to the breeder in the circumstances under which it is practised. The geneticist can help the breeder when the latter has stated his policy and has defined, more or less exactly, what he wishes to produce. The geneticist can discuss the methods of production, but the reasons for production fall outside his field.

Principle and Practice.

The scientist is concerned with the disclosure of facts—verifiable scientific facts—and with the search for principle; the practitioner of agriculture is concerned with the weaving of these facts into the warp and woof of agricultural policies. It is for the scientist to advance knowledge; it is for the agriculturalist to transform knowledge into wise action.

A definition of what the breeder wishes to produce leads at once to the construction of standards of excellence and thus to serious difficulty. These standards are necessarily complex, because it is impossible to concentrate on one or two qualities, such as meat or milk or wool production, and to neglect the animal as a whole; the ideal animal must live, thrive and reproduce in a particular environment as well as provide certain animal commodities. Type is meaningless without reference to habitat and destiny. Another difficulty that stands in the way of standard making is that too commonly the general economics of production are complex; for example, the destiny of a mountain breed of sheep may be the production of ewes for crossing with rams of a larger lowland breed in order to produce the best kind of fat lamb. The standard of the mountain breed in a case such as this is applied only to the female, for the function of the male is to produce females, whilst that of the lowland breed pertains mainly to the ram. Moreover, standards quite commonly cannot be consistent, since it may be impossible to obtain in a single animal the full development of all the desired points of excellence.

All too commonly the standards are set, not by

the breeder, but by the buyer, who knows little, if anything, of breeding. For example, one hears a great deal to-day of the need for improvement of the fleece of the sheep, but the voice one hears is the voice of the manufactuer of textile goods, who apparently regards the sheep merely as a vehicle of a fleece out of which he is destined to manufacture socks and semits at a reasonable profit to himself. But the breeder has quite different standards; to him the fleece is a protective covering for the lamb and for the sheep, contributing to the development of such qualities as hardiness—the fleece must be of such a kind as will help his sheep to thrive, for he has to consider fertility, milk yield, growth rate and fitness in relation to the particular system of husbandry and to the geological and climatic conditions of his farm. The sheep breeder in this country knows that mutton can always command a fair and steady price in the regional markets, whereas the fluctuations in the price of any particular grade of wool are profound and most unsettling. He therefore regards mutton production as the more important aspect of husbandry and wool merely as a by-product. Two sets of interests must be considered when drawing up the standard of the ideal, the breeder's and the textile manufacturer's, but of the two the breeder's must remain the more important.

An Urgent Demand.

Breeding is a synthetic operation, and before there can be intelligent controlled synthesis there must be analysis. One of the most urgent demands in animal breeding is the scientific analysis of excellence, and a study of the interrelationships of the various characters which in their combination constitute the ideal and of the mode of their inheritance. The methods of improvement, through breeding, are simple and straightforward. Developments in genetical science have not changed them, but have merely refined them and have explained their success. A recognition of the broad fact that the majority of the component characters in any ideal type are dominant in the Mendelian sense, and that the majority of undesirable characters are recessive, enables us to understand many things; for example, the facts that it is not to be expected that the progeny of a mating shall be of the desired standard unless the parents approach that standard; that the greatest chance of obtaining an individual of excellence is provided when parents, excellent themselves, and related one to the other, are used.

There is only one sure way of improving the livestock of a country, and that is by improving the stock-breeder. This can be done by improving his education and by offering rewards for ability. At the present time the shows are not such important agents in livestock improvement as they were in days gone by, for far too much importance is given to standards which have no relation to economic worthiness; the showyard is somewhat blind to commercial realities and tends to encourage grossly uneconomical husbandry.

The Ideal Type.

To-day the prize is too commonly given to the man who exhibits the best fitted animal and not to the animal that is the nearest to the ideal economic type. The fact that pedigree as an instrument wherewith to assess worthiness is not enough, is not clearly recognized, and the prize is too often given to the best looker and not to the best performer. The milk record, the bacon quality, the pulling power, the egg record, the fertility record, must overshadow the preferences of prejudiced judges; judgment must be impersonal and based on a record of performance, on productivity, on thriftiness and resistance to disease, before the shows can play their proper role in livestock improvement schemes.

Positive methods of livestock improvement aim at the provision of stock of known genetic constitution and possessing an accurate record of performance. Such schemes necessarily involve considerable genetical analysis of standards and of stock. Most, if not all, premium schemes thus far developed possess little, if any, value, for the reason that no sufficiently comprehensive records have been maintained. Nor can they ever be until all licensed sires become the property of the State and the experimental material of the scientist. All State intervention of this kind assumes that breeders generally are either incapable of assessing the real value of an individual or individuals at all accurately, or else cannot, for financial reasons, provide suitable sires for themselves. This attitude is amply justified, for there is no indication that there has been any rapid multiplication of the very good animals, and a corresponding reduction in the number of the inferior animals in the livestock population in this country. The general level of excellence of the commercial stock of this country is pitifully low. One of the most urgent tasks to be undertaken is the remedying of this state of things.

The first step to be taken is the breeding of pedigree stock according to genetically approved systems of breeding. The next step is to grade up commercial stocks by means of pedigreed sires and to produce first crosses for certain commercial purposes by the use of two pure-bred stocks. It is highly probable

that for the special purpose of meat production the first cross will always be used. But the production of the first cross with its hybrid vigour depends entirely on the pre-existence of two complementary or compensatory types of pure bred, and the success which now attends, and will attend, this system of breeding depends entirely upon the existence and maintenance of pure-bred stocks that can be crossed with advantage. The uniformity of excellence of the first cross is determined by the genetic purity of the parental stocks. In this production of first crosses of exceptional economic worth, large numbers of pure-bred stock of the highest quality are needed. These latter are also absolutely necessary for the most important yet simple task of grading up the pure-bred commercial stock of the country. It would seem to be the case, moreover, that in those instances in which the desired production depends on an intensive degree of development of relatively simply single functions, such as milk or wool production, the pure-bred is better than the first cross, and so for these purposes great numbers of graded pure-bred commercial animals are required.

It is accepted that every possible economy in agricultural practice must be effected. Yet one does not have to travel far to find extravagances, probably preventable. For example, there is reason to think that the average life of a dairy cow is not more than three lactations, that one-quarter of the dairy cow population of Scotland is replaced annually, that 40-50 per cent of all mares put to the stallion each year fail to produce a foal. Surely these are matters of grave concern, for it has to be recognized that in all probability half this trouble is genetic in origin. At the present time we do not know what are the causes of this disposal of dairy cows before the reproductive phase of their life history is passed, but we may assume that 20 per cent or more are disposed of because they have proved themselves to be genetically inferior animals.

New Standards.

There is reason to hold the view that about 50 per cent of infertile matings are due to genetic causes. There is no doubt that low fertility, sterility, can be bred into a stock, and that it is the soundest of policies to breed for fertility at the same time as one is selecting for other qualities of economic worth. The time must come when some standard of merit based on breeding record for mares, both in the show ring and in the stud book will be required. Regularity in breeding will be regarded as a highly-prized character, and the buyer will then be able to assess the fertility of the stock he buys and the menace of sterility will have been removed.

Breeding is the solid foundation upon which all schemes of improvement must be built; expert husbandry can do much, but it cannot transform the hereditarily deficient into highly productive stock. The need for improving quality and for lowering costs of production is pressing. It can be met very largely by breeding for increased productivity in order to lower costs of production and by breeding for quality in order to increase returns. For milk production the first essential is to have high producers, to choose a bull on his dam's record and not upon the record of his sire's dam, to discard low producers and their progeny and to attempt to raise the level of production of the high producers by selection and careful breeding. There will be no problem of surplus milk if the low producers are eliminated and the average yield thereby improved. It is not generally recognized that one cow yielding 1,000 gallons is as profitable to her owner as are five, each of which produce but 650 gallons per lactation. Improvement in beef production is not so simple a matter, for the dairy industry is responsible for the presence of great numbers of unsatisfactory stores. But the use of a good beef type sire for the unwanted calf of the dairy cow would do much to relieve the situation. It is in this connexion that the scrub bull is at present so serious a menace.

Co-operation Needed.

These, then, are some of the problems which have to be investigated and solved by breeder and geneticist working in harmonious collaboration—the definition of standards, the analysis of excellence, the purification of stocks, the removal of the menace of sterility. The geneticist is completely ready to place his specialist knowledge of the fact and of method at the service of the industry, but the agriculturalist is not yet ready to take advantage of the proferred help. Before this can become really effective, there must be new attitudes exhibited; the breed societies must begin to think nationally as well as scientifically, standards must be modified, stud, herd and flock records must be far more comprehensive and must include the worst as well as the best, for failures are as important as successes in genetical analysis. It will be regrettable if the practitioner turns to the science only when forced to do so by financial anxiety, for science can give the joy of understanding and the thrill of power, which are contributions no less valuable than those which pertain to the materialities of existence.

Though it is unwise to prophesy, it is permitted to exhibit reasonable expectation. During recent years

work in the field of endocrinology has been exceedingly active, and to-day we are in possession of a great body of scientific fact which bears very directly indeed upon the problems of livestock breeding. If we examine these problems, we find that they refer to the phenomena of growth, fecundity, fertility, lactation and metabolic rate. It is in respect of these that the good type differs from the bad. Moreover, it is differences in the rate of growth, ultimate body size, the degree of fertility, the duration and intensity of lactation and in the level of metabolism that distinguish the present-day domestic stock from their wild progenitors. Now it is established beyond all doubt that differences in these characters are directly referable to the action of certain endocrine glands, especially to that of the pituitary. We know that the elaborated products of this gland determine the rate of growth and the limit of growth, the number of eggs available for fertilization, the intensity and duration of lactation and the intensity of the metabolism, and, also, working through the thyroid and the sex glands, the local deposition of fat. It would seem, then, that what artificial selection and controlled breeding have done has been to isolate and develop strains of animals remarkable for certain types of pituitary, thyroid and sex gland functioning. Reference to the various types of man produced by the various kinds and grades of disorder of these ductless glands will reveal every type of domestic animal of economic importance. That which is abnormal in man is the standard of the ideal among his animals.

Chemical Control.

If this is so, we may assume with confidence that the future will see a very widespread application of the facts of endocrinology to the problems of animal breeding. That which presently is attained only by the exceedingly slow process of selective breeding will be achieved in each generation by the administration of the appropriate endocrine product prepared by the biochemist. The rate of growth, for example, will be controlled by the administration of the appropriate pituitary preparation; other preparations will be used to control fertility, fat deposition and so forth, and then the breeder will not depend for success upon his incomplete control of the somewhat blind forces of Nature, but will have the power to do whatever he will through his ability to supply to the animal those substances which control all those vital processes which are concerned in the development of qualities of economic worth.

The lag between demonstrated scientific fact and its incorporation into practice is usually about twenty to fifty years. All these things can be done at the present time in the case of animals of no economic importance, such as the rat and the mouse. Surely, in this country, there must be those who would wish to see this work extended without delay to the horse, the cow, the sheep and the pig. But the fact is that there is no research institution in this country that is in a position to undertake such work, nor will there be until the livestock industry becomes aware of the promise that this work offers, and demands that those scientists who are enrolled in its service shall be provided with the means to work with the animals of the farm, and not solely with animals that the livestock breeders would call vermin.

New Light on the Flood.

In common with other events recorded in the early books of the Bible once regarded as historical, the Flood in modern times has come to be looked upon as a myth. The spade of the archaeologist, however, beginning with the excavations of Schliemann at Troy and Mycenae, has brought to light a mass of evidence which goes to show that many of the so-called myths have a basis of historical fact—much, for instance, of the material of Greek mythology and the Homeric poems, to take the more striking examples. The latest addition to these rehabilitated records is the story of the Flood. Both at Ur and Kish in 1928 a layer of clay was found which can only be interpreted as evidence of a considerable inundation. This must have been of such proportions as would warrant its identification with the flood mentioned in the epic of Gilgamesh, inscribed on the clay tablets from Nineveh now preserved in the British Museum and elsewhere. The Hebrew story in *Genesis* presents many close similarities to the Mesopotamian story, as Mr. Harold Peake shows in his new book on "The Flood" (Kegan Paul, 5s.). With his usual facility and imaginative insight, he advances many suggestive theories to meet the difficulties of the evidence found during recent years. Although the story of the flood is world-wide in its distribution, the similarities between the different versions are not sufficiently close to warrant attribution to a common origin, except in these two cases. It is probable, therefore, that these versions represent a traditional record of a great inundation of the Tigris-Euphrates area, a purely local event, which was carried back to Palestine after the Captivity.

The importance of these discoveries is emphasized when we remember that the events concerned took place five thousand years ago. The excavators have now obtained evidence relating to the inhabitants of Ur before the Flood.

From Mud to Mountains.

By J. E. Pryde-Hughes, F.R.A.I.

Some weeks ago Mr. Pryde-Hughes returned from another of his minor explorations in post-war Central Europe. This time he travelled along the River Waag to the Tatra peaks, where the Slovak peasants still call their picturesque lakes the "Eyes of the Sea."

BEFORE the war, when Slovakia was part of the kingdom of Hungary, game abounded in the Tatra mountains and herds of powerful buffalo roamed at will. These dangerous beasts provided royal sport, and were fairly common. But since I did not meet or hear of any on my recent voyage along the Waag—from the mud springs of Piestany to the peaks of the High Tatra group of the Carpathians, under the Polish frontier—I must take it for granted that the buffalo are much rarer nowadays, if they exist at all in a wild state.

A journey through Czecho-Slovakia to the Waag, and then along the valley up to the mountains, opens up a new post-war world, much altered in many respects from its condition under the old Austro-Hungarian regime. Blest with an abundance of springs of medicinal waters, the land is rapidly becoming dotted with health spas, bright and charming places which, as far as I could see, really are advantageous to sufferers from those specific troubles for which the waters are recommended.

POTATO CULTIVATION.
In the Tatra mountain districts potatoes are carefully cultivated by the peasants, who still wear their traditional costume.

I had no troubles, except a longing for the mountains, so my appreciation goes for little. I did long for the mountains; and even the attractions of Prague, the Riesengebirge, and several magnetic *kurorts* failed to hold me back. Piestany did restrain my journey to the High Tatra for a short while, not because it proves its claims to be beneficial in cases of gout, rheumatism, etc., but because the idea of a natural radio-active mud bubbling up in the middle of a broad river fascinated me. The gallery or museum of crutches may interest those who are morbid or have reason to hate crutches, but an island swimming on a mud bath in the middle of a river, and steaming baths of mud for bathing, I suppose called up instinctive memories from the "mud-pie" age—a time for me of the full enjoyment of life, as it was, I am sure, for thousands of other dirty toddlers!

The natural thermal sulphur and mud springs at Piestany are of volcanic origin. The power of the springs may be gathered from their high temperature, which is 142-153° F. This high temperature is particularly valuable in the sulphur baths because it eliminates the need for artificial heating. The thermal radio-active mud is a natural sediment from inexhaustible springs, which bring the mud up in the form of a particularly soft grey mass from the bowels of the earth. Geologists estimate that the thermal springs rise from a depth of about 4,900 feet, from a large basin filled with a mixture of sulphated waters, muddy deposit, and large quantities of sulphurous gases. These products escape by volcanic action through various cracks and fissures, which in course of ages have become filled with loose masses of earth. The sulphur gases drive the mud mixed with sulphated waters to the surface through this loose mass. There are thus not only separate springs but a whole region of springs, mainly on the so-called Bath Island, where if one digs down six to twelve feet one comes upon a mixture of warm sulphur water and mud. The springs also well up in mid-stream, so that clouds of warm sulphurous vapour are given off from the surfaces of the water.

Piestany lies 530 feet above sea-level on the Waag, a tributary of the Danube, and is between three and

four hours railway journey from Budapest and Vienna, or one and a half hours from Bratislava, the largest town in Slovakia. Its history may be followed back authentically to the beginning of the twelfth century. In the year 1671, Edward Brown, in his *Acta Anglicana,* counts up fifteen pools on the Banka side, of which the largest could hold a hundred persons. It is a delightful district, its charms being not merely in its baths, its society, facilities for sport and such amenities of a fashionable spa, but in the interesting natives, picturesque in their traditional costume, and in the numerous ruins. There is first the castle of Cachtice, the home in the seventeenth century of the notorious Princess Elizabeth Bathory, who is said to have decoyed and killed over three hundred peasant girls in order that she might have her regular bath in human blood, which she believed to have a beautifying effect on the skin ! Beyond are the ruins of Becko and Trencin, the latter a celebrated fortress in Roman times, and to-day overlooking a developing spa. From here the way proceeds up the valley, slowly rising now, with the hills becoming more dominant, the countryside more wild, to Strba and Poprad at the foot of the Tatra mountains, and to Kosice in the heart of Slovakia.

Strba is in a valley. A cog-wheel railway climbs up to Strbské Pleso, the gorgeous resort on the crest of the Tatra mountains, but shielded from the north by the great peaks of Poland beyond—rugged grandeur on one hand, on the other a wild wooded terrain in hill and valley, the home of falcon and eagle, the marmot, chamois and bear, and in the deep forest of wild boar and deer.

Among the high mountains, chief of which are Gerlachovka (7,900 feet), Krivan (about 7,300 feet) and Lomnicky Stit, are a number of deep lakes of clear glacial water called " Plesa." There is one at the head of the Strba cog-rail, which gives its name to the very delightful summer resort and winter sports centre of Strbske Pleso. Such a lake is known amongst Slovak people as an " eye of the sea," that is a lake through which the sea is said to gaze at the heavens. There is another named Popradske Pleso, 4,600 feet above sea-level, and again another called Zabie (or " frog ") because of its shape. The hillsides down to the valley are clad with virgin forest, and zig-zagging through these are mountain torrents, here and there splashing over huge boulders and cliffs in sparkling cascades.

The steel-grey higher peaks, rising above the perpetual snow line, and forming a V-shaped wedge into Slovakia, are in the east, where junction is made with the Zdarske Hole (also known as Zdarske Tatry). The latter are of limestone, while the main High Tatras themselves are of granite. There are few passes over the range, and this is perhaps why in these frontier regions no special precautions seem to be taken. One day I did meet two colossal fellows

VOLCANIC SPRINGS IN THE RIVER WAAG.

Mud is here being collected from the thermal springs at Piestany, which it is estimated rise from a depth of nearly 5,000 feet.

SUN AND SHADOW AT STRBSKE PLESO.
This lake is one of several in the mountains known to the peasants as "eyes of the sea," as through them the sea is said to gazé at the heavens.

with carbines, in a sort of hunter's uniform, when ski-ing along a mountain path northwards, but they merely smiled in a friendly manner, evidently aware that I was foreign and likely to look timidly on frontier guards.

In these mountains there are no glaciers, but the watershed sends its water east to the Black Sea and north-west to the Baltic. The Waag carries the water to the Danube and on to the Black Sea, while the Poprad is a tributary of the Dunajec, which enters the Vistula and thence the Baltic.

Though the new post-war state has endeavoured, with considerable success, to develop holiday resorts on the narrow plateau overlooking the valley to the lesser Tatras, the Carpathian regions remain wild and attractive to the lover of solitude and unrestrained nature. Dense pine woods give way to pasturages and patches of scrubby moor. Much timber was requisitioned from the woodlands during the war, yet despite vast inroads there are still primitive forests where the dramas of savage life are staged undisturbed, and where the tourist has not yet reached out his devastating hand amidst the abundant flora.

An ideal path for the amateur tramp can be followed along the railway line from Poprad, with the Carpathian mountains ever on the left hand, offering food for thought in history and myth. Sombre acres of pine woods are rather depressing, even when one realizes that the unpathed forests are alive with wild beasts and fowl. But all along the route are many sparkling rivulets, chattering over rocky beds ; isolated villages where every wayfarer finds a natural welcome ; and romantic castles like that at Spis, perched on a rock 600 feet high. Most of them, of course, are in ruins. Spis has been derelict since 1780 when it was gutted by fire. This was once a grand place with over one hundred rooms and fine large courts, which in the fifteenth century belonged to Jan Jiskra of Brandys.

And so, although there may not be an opportunity to speak one's own language for days on end, there is plenty to interest the traveller inthe wilds of the Carpathians. Whether visited in summer or winter, the mountains are equally attractive.

Book Reviews.

Report of the Channel Tunnel Committee. March, 1930. (H.M. Stationery Office. 3*s*.).

The first proposal for the construction of a submarine tunnel between England and France was made as far back as 1800. Later in the century some preliminary plans were laid before the Emperor Napoleon III, and in 1867 an international committee was appointed at his suggestion to draw up a scheme. Later still the English promoters obtained official sanction to form the Channel Tunnel Company, Ltd., but in 1883 Parliament expressed apprehension on military grounds, and the tunnel was pronounced to be contrary to defensive interests. That was before the days of electricity when it is certain, in the light of modern experience, that the ventilation problem would have been insoluble. In subsequent years the scheme was brought unsuccessfully to the notice of the Government no fewer than eleven times, until in April, 1929, a Committee was appointed " to examine and report on the economic aspects of proposals for the construction of a channel tunnel or other new form of cross-channel communication."

The outcome of the enquiry is a favourable verdict, only one member of the Committee, Lord Ebbisham, dissenting. The greater part of the document deals with problems of traffic, employment, and the effects on existing industries. Questions of sovereignity and jurisdiction that would require international settlement are discussed, but military and political implications were outside the terms of reference.

Alternative proposals to a tunnel are dismissed mainly on grounds of expense. A bridge, for example, while apparently practicable from the constructional standpoint, would cost £75,000,000, and would be a great hindrance to shipping. Another suggestion that the train tunnel should be accompanied by a second tunnel for road traffic is ruled out for reasons of ventilation. Any tunnel under the channel would of necessity be constructed in the form of an inverted syphon, the lowest part of which would be some 300 to 400 feet lower than either end. The carbon monoxide given off by motor exhausts is fatal to human life, and being heavier than air it would accumulate in the lower levels of the tunnel. The Committee are advised that it is extremely doubtful whether any blower or suction fan could be made of sufficient power to drive such gas from a tunnel 36 miles long—a difficulty that was anticipated in *Discovery* before the enquiry commenced a year ago. A tunnel for electric trains is therefore the principal subject of the report.

The construction of a tunnel presupposes geological conditions suitable to the project. The formation of the Channel Straits is the crux of the whole question. The company promoters are apparently satisfied that enough evidence is already available to allow an immediate start on a pilot tunnel. As, however, the existing facts were obtained by French geologists over fifty years ago, and were not made over the entire distance, the eminent engineers consulted by the Committee recommend that samples and soundings should first be obtained from areas on which sufficient data are not at present available. The existence of an uninterrupted bed of lower chalk has been neither proved nor disproved by the soundings and surface samples already taken. Difficulties referred to by the engineers include possible fissures or infilled valleys. With the development of engineering resources the former would not present any insuperable difficulty, unless of exceptional size. On the other hand, the position would be very serious in regard to an infilled valley charged with water at a pressure of say 150 lbs. per square inch. " But even in that event," the Committee state, " the consulting engineers hesitate to say that the project would have to be abandoned, as it might be possible to deal with it by a shield with an entirely closed face, the excavation being removed by powerful water pits and washed through controlled pipes in the bulkhead." So far so good. But on turning to the actual words of the engineers' report (given in Appendix I) we find the following sentence added : " This, however, has never been tried except experimentally, and we are not aware of any tunnel which has been driven under such conditions as we have outlined above."

When this cautious reservation is read together with the adverse opinions expressed by the engineers on other processes (compressed-air working, ground freezing and cementation), it becomes clear that the problem would be much more difficult than is to be inferred from the wording of the Committee's report. Evidently, having satisfied themselves on other grounds that a tunnel would be justified, the Committee were predisposed to read this view into the engineers' evidence, which was submitted towards the end of the enquiry. Hence the different emphasis in the two documents. It is easy enough to allow the economic considerations to obscure the scientific issue—and certainly more popular to praise the scheme—but until a thorough investigation has been made by expert geologists, the Channel Tunnel cannot be regarded as feasible from the scientific standpoint.

Wild Exmoor through the Year. By E. W. Hendy. (Jonathan Cape. 10*s*. 6*d*.)

As natural historian of the western parts of Somerset Mr. Hendy has a deserved reputation, which his newest volume can only serve to confirm. Although primarily a bird-watcher, he brings within his scope as wide a variety of country matters as Gilbert White, treating them with an uncommon blend of sense and sensibility which gives a characteristic freshness to his work. Here we must be content with mentioning two special problems upon which he speaks with authority—stag-hunting and the protection of birds. Although not a stag-hunter himself Mr. Hendy, from a field naturalist's standpoint, is a convinced supporter of the sport. He reminds us that historically it was the Hunt which saved the wild red deer from imminent extinction on Exmoor about the middle of last century, and that the present herd of six hundred odd would prove much too destructive to preserve at large if hunting were suppressed and nothing put in its place. If, on the other hand, thinning by rifle were adopted as an alternative, he contends that danger and cruelty would be increased and the goodwill of the neighbourhood alienated through loss of the Hunt with its prestige and compensation. Corraling in the cramped space which alone could be spared for such a purpose, or solution of the problem by annihilation of the herd, he rightly condemns as deplorable policies. We must not, however, forget that there has never been any prospect of pathologically humanitarian opinion stampeding us into desperate measures; the origin of the rather widespread disapproval of the Hunt among reasonable people is to be traced to a handful of isolated incidents of apparently inexcusable brutality which were not, as they clearly should have been, disowned by its responsible heads. No doubt the agitation will serve its purpose, without proceeding to undesirable lengths.

Mr. Hendy's chapter on bird protection gives a clear statement of his considered view, and is among the boldest and most convincing we have read. If there were a couple of dozen people equally clear-sighted and determined, with the necessary leisure, we could undoubtedly do for bird protection what fifty years of futile legislation and scheming by ineffective societies have not succeeded in doing. The failure through a mixture of cowardice and stupidity to take the offensive against the few rich and selfish collectors who have already done untold damage among our rarer birds has long been recognized as a disgrace to British ornithology. All are in theory against this destructive clique, but few share with Mr. Hendy the courage of their convictions, and this apathy makes it waste of time at present to discuss any proposals which mean business. He has done a public service in pointing out exactly where official bird protection breaks down, and although at some points readers have inevitably to be left to draw their own conclusions, they will no doubt succeed in doing so.

E. M. NICHOLSON.

Centenary of Henry Hill Hickman: Souvenir Volume. (The Wellcome Foundation, Ltd., London).

For centuries the records of history show that the physician and surgeon searched for an agent which might prevent pain in surgical operations. Up to the end of the eighteenth century numerous potions were used. In 1800 Humphry Davy, who was then employed by Beddoes in his Pneumatic Institution at Clifton, began to study the medicinal effects of different gases by inhalation on the plan devised by Priestley in 1767. The use of gases by inhalation was, therefore, well known by the early part of the nineteenth century, and it is surprising that earlier experiments were not made to use nitrous oxide and other gases as anaesthetics. One man, Henry Hill Hickman, made the attempt. The centenary of his death took place on 2nd April, 1930. To commemorate the occasion this book has been prepared by the Wellcome Historical Medical Museum, in which the documents relating to Hickman's work have been published in full detail. In the foreword Dr. Buxton writes :—

"Hickman recognized that vapours introduced into the lungs and thence into the circulation of the blood should provide a means of ensuring sleep for the sufferers who had to face the surgeon's knife. He grasped the principle—the method was to follow. We must appreciate in Hickman the true scientist. He set about to prove the principle by adopting the correct methods of research. His experiments are remarkable, when we envisage the days in which he lived; also they are accurate, so far as the physiology of his day could make them. He sought for a means whereby he could produce anaesthesia in animals by inhalation, and he adopted recognized gases as a means of arriving at this end. Further, he believed that his methods would not only lead him to the discovery of anaesthesia, but would also enable him to prevent hemorrhage. Unfortunately, his protocols do not supply all the details of the experiments, though we are led to believe that true anaesthesia rather than asphyxia was one of the lines along which his investigations were conducted. His work with carbon dioxide was certainly along a correct path, and was a long way ahead of his times."

The value of Hickman's work was not appreciated by his contemporaries either in England or in Paris, and after an uphill struggle for recognition, he died at the early age of thirty years. Nor at the present time do the thousands who enjoy the benefits of "gas" realize to whom they are originally indebted. The publication of this volume is therefore an important addition to the popular history of medicine. An excellent portrait of the pioneer it commemorates is supplemented with facsimile reproductions from his writings, and with other photographs illustrating his interesting career.

Photo-Electric Cells. By NORMAN ROBERT CAMPBELL and DOROTHY RITCHIE, Research Staff, General Electric Company. (Pitman. 15*s.*).

Television To-day and To-morrow. By SYDNEY A. MOSELEY and H. J. BARTON CHAPPLE, Wh.Sc., B.Sc. (Pitman. 7*s.* 6*d.*).

The first of these books supplies a very long-felt want. Dr. Norman Campbell's name on the title page is a guarantee of the value of the book, because he may justly be regarded as the foremost authority on the subject in this country. He and his co-author, Dorothy Ritchie, have produced an admirable book. The keynote of their work may be found in a phrase on page 153. "We are unwilling to enter at all into a region which the limits . . . of our knowledge would forbid us to explore completely."

The book is divided into three parts: (1) the theory, (2) the use, (3) the applications of photo-electric cells. Naturally, to the professional physicist Part 2 is the most interesting as the authors have given freely of their very large experience. The comparative merits and characteristics of vacuum and gas filled cells are fully and fairly set forth, and also the various methods of amplification are discussed with the meticulous care and accuracy of expression that we have learnt to associate with the work of Dr. Campbell. It is conceivable by the reviewer that there are workers who might disagree with some of the authors' conclusions, but the inexperienced reader may safely trust to the specialized experience which is the basis of this concise and valuable contribution to the subject.

With the advent of television and the increased application of physical methods in industry an ever-growing number of highly competent amateurs will read this book. To them Parts 1 and 3 will be of very great interest. We are presented here not with a theoretical treatise on the subject, but an advanced practical guide in the choice and technique of photo-electric cells, however and wherever it may be useful or desirable to employ them.

From time to time *Discovery* has stoutly stood forth as the sympathizer and champion of the much attacked subject of television. It would now appear that the attitude is vindicated. The second book is a remarkable one. As a journalistic description of a new scientific advance it leaves nothing to be desired. The whole subject of television is reviewed and explained in a very readable manner. One cannot fail to be impressed with the importance of the subject, and every reader will be intensely interested. The authors know their subject and impart their knowledge with authority and determination. The amateur experimenter is regaled with a tempting array of circuit diagrams and a roseate prospect of unlimited experimental activity. He has also in this book a practical guide of really valuable scientific information, presumably due chiefly to the second author.

Television was first demonstrated in 1926, and the somewhat grotesque, albeit encouraging results, compared with the most realistic televised pictures of to-day, affords most convincing testimony of the progress that has been achieved. One of the

early problems which was largely responsible for the delay in placing televisors in the hands of the public was the difficulty of realizing automatic synchronization, or uniformity in "scanning" the subject and reproducing the image at a distance. This has now been overcome by the ingenuity of Mr. Baird, and the chapter dealing with the development of this branch of the work is exceptionally good. In spite of some fundamental doubts which naturally occur to the critic, it seems very certain that television has not only come to stay but to develop into the same popularity and universal use as the familiar "wireless."

Television! Noctovision! Phonovision! The very names, apart from the phenomena for which they stand, are overpowering. If these things become commonplace, as they surely will, they cannot fail to have a drastic effect on the psychology of humanity. Mr. Moseley in his Preface forecasts the development of an apparatus for projecting love impulses. Perhaps an Amoscope or even an Erotojector!! Thus it seems that love, too, must go, like all outdated things, for electrons have now usurped the field where once Zephir and Aurora played.

Mr. Baird has written a Foreword restrained in expression with regard to his obvious disappointments concerning the facilities he has lacked, but full of optimism with regard to his future work.

V. E. Pullin.

The Daniel Guggenheim International Safe Aircraft Competition. Final Report. 31st January, 1930. (New York.)

The Daniel Guggenheim Fund for the Promotion of Aeronautics, whose successful demonstration of the safety of fog flying was described in *Discovery* last December, recently organized a safe aircraft competition. The object was "to achieve a real advance in the safety of flying through improvement in the aerodynamic characteristics of heavier-than-air craft, without sacrificing the good practical qualities of the present-day machines." From the total of twenty-seven entries only fifteen aeroplanes appeared at Mitchell Field, where the tests were conducted, and the safety prize was won by the Curtiss "Tanager."

Although no new device was developed particularly for the competition, the entries covered the whole field of features which, either practically or theoretically, are expected to improve the control or speed range of aircraft. The results showed that the use of "variable incidence" wings appears to have little or no justification. The advantages of variable wing area and camber could not be determined, owing to the unsatisfactory flying characteristics of the aircraft using these features. On the other hand, the advantages of slot and flaps in lowering the minimum speed were clearly shown. The aeroplane equipped with floating ailerons exhibited unusually good controllability at speeds near the minimum, either with or without slots and flaps. In general, the competition appeared to show that the design and construction of an aeroplane which will successfully meet a given set of conditions, can best be handled by a manufacturer having a well-equipped and experienced engineering division. It is regretted that all of the original competitors did not submit aircraft for demonstration; the absence of the autogiro was particularly disappointing, since no results of its performance directly comparable with other types of aircraft are available. Except for the Curtiss machine, the only plane to approach in any way the required conditions was the British Handley-Page entry. This proved to be an excellent flying machine, and with the exception of a few items, proved to be on a par with the prize-winner.

Brakes were installed on nearly all the entries for the purpose of shortening the landing run and for providing control on the ground. With the exception of the Handley-Page plane; the brakes were controlled by foot pedals or levers and could be used to steer the plane while on the ground. The Handley-Page plane was, at times, difficult to handle on the ground in a cross wind owing to the method of applying both brakes at once, and to the excessive flexibility of the landing gear when not pumped up to the proper pressure. The brakes of the Handley-Page were operated by a hand lever which was difficult to reach owing to the cramped position of the pilot in the cockpit. These are, however, details which can be easily remedied, and it is satisfactory to know that a British aeroplane maintains our national reputation, in a competition which only the most up-to-date standards could satisfy.

Journal of the Marine Biological Association of the United Kingdom. March, 1930. (10s. 6d.).

The journal under review is appropriately prefaced by a striking tribute to the work of the late Sir Ray Lankester, one of the founders of the Marine Biological Association.

Of the general contents of the new issue, perhaps the most interesting is an account by Dr. J. H. Orton, chief naturalist at the Plymouth Laboratory, of experiments on the value of special paints, designed to protect the submerged surfaces of ships from growths. In the course of studying the breeding and growth of marine vertebrates—work which has been carried out, with the exception of the war period, since 1911—it was recently recognized that this would form an invaluable basis for investigating the properties of "anti-fouling" paints, that is to say, paints having usually poisonous properties. Painted shells and boards were accordingly placed in the sea in different situations, and compared with the normal general growth in the locality. By observing this experimental material over a period of years, it has been possible to determine the age at which these paints lose their special properties, and to investigate their condition by chemical analysis.

The results clearly show that the only effective anti-fouling materials are red copper and dark green arsenic paints. It is also evident that the anti-fouling property depends upon the retention of the paint on a substratum. All paints are retained better on wood than on shells, and better on a rougher face of the shells than on the smooth face. Generally speaking, the growth of marine animals will be inhibited for a period depending upon the retention of the paint on the surface it is desired to protect, and upon the existence in the paint of substances which maintain a toxic surface. It has been demonstrated that a dark green arsenic paint remained toxic for a longer period than those containing red copper and light green arsenic, and that the durability of the matrix of the paint is a fundamental character of efficient paints. It is also clear that, beyond a certain concentration of poison in the paint, the durability of the matrix is more important than the nature of the poison.

As the life of any paint in the sea must necessarily be short, being dependent on the longevity of the matrix, Dr. Orton concludes that the problem of maintaining the bottoms of ships free from growths, for periods reckoned in years, must be solved by some other means than the application of paint—unless a permanent matrix can be discovered.